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U1S S1820

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EP 0131211 A1 WO 95/11146 A1

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ONLINE:WPI

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(54) **Remote vehicle programming system**

(57) A vehicle accessory control system includes a receiver for receiving paging signals including a unique vehicle address and a reprogramming signal. The control system responds to the reprogramming signal by reprogramming a vehicle accessory control program used to determine how to specifically control a vehicle accessory.

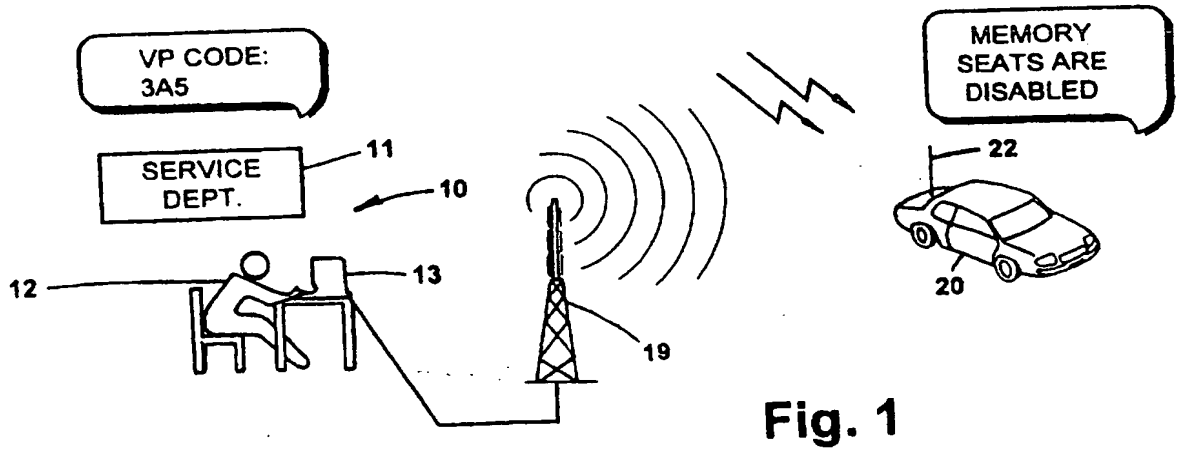


Fig. 1

GB 2 298 070 A

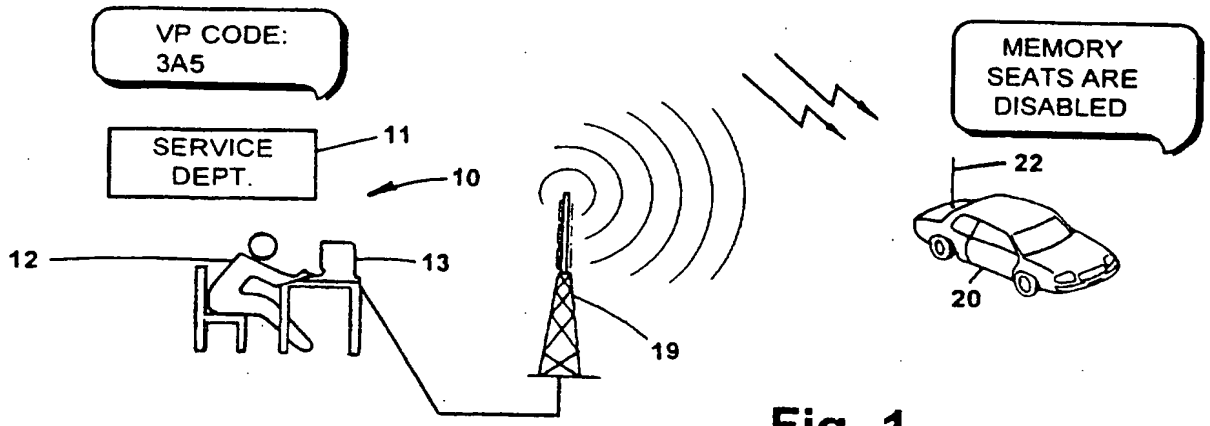

VP CODE:
3A5
SERVICE
DEPT.
11
10
12
13
19
MEMORY
SEATS ARE
DISABLED
22
20

Fig. 1

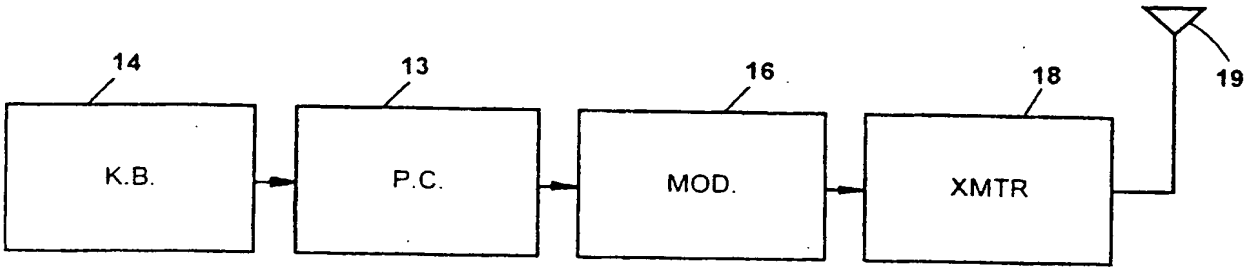

14
K.B.
13
P.C.
16
MOD.
18
XMTR
19

Fig. 2

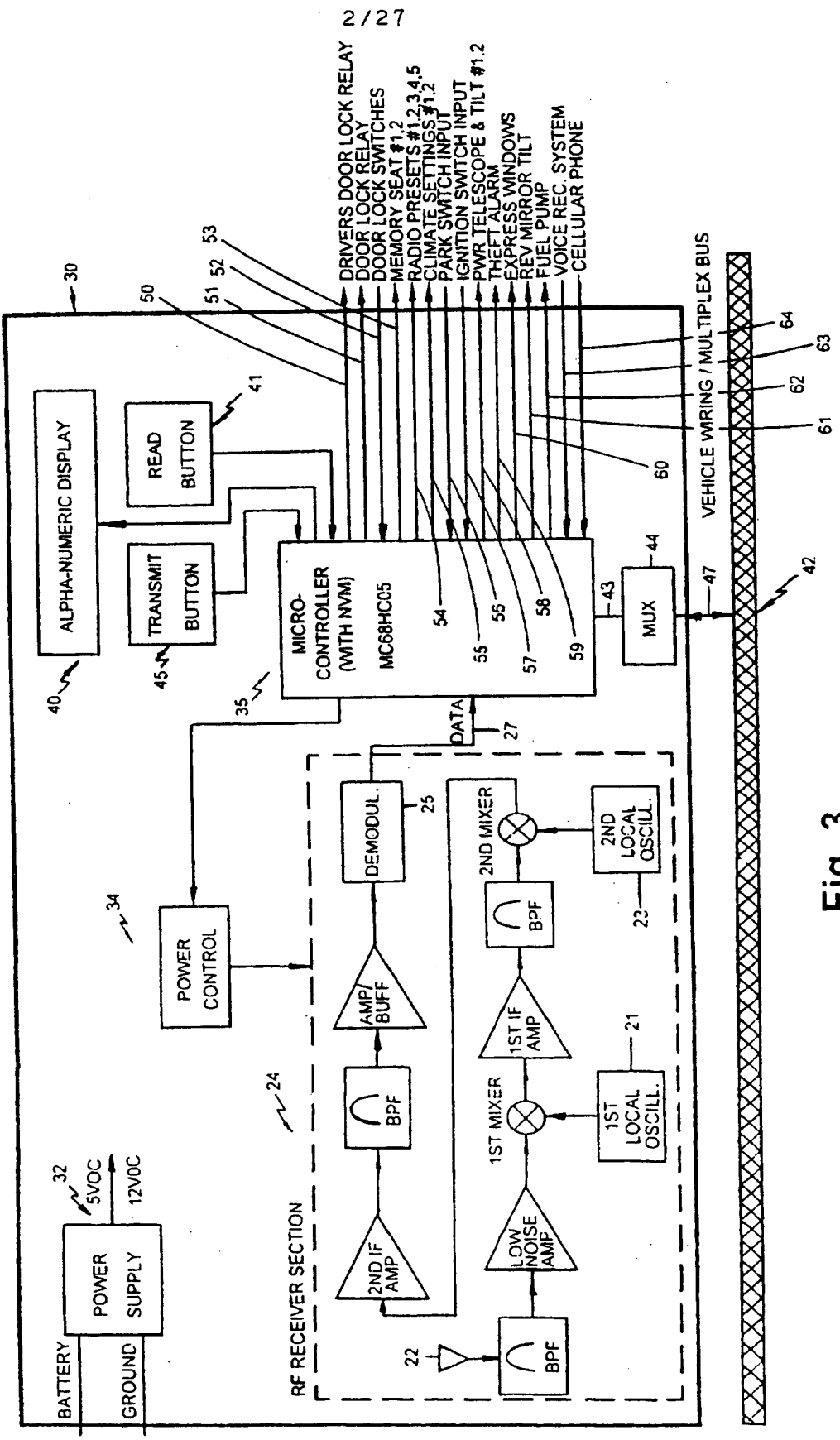

DRIVERS DOOR LOCK RELAY
DOOR LOCK RELAY
DOOR LOCK SWITCHES
MEMORY SEAT #1,2
RADIO PRESETS #1,2,3,4,5
CLIMATE SETTINGS #1,2
PARK SWITCH INPUT
IGNITION SWITCH INPUT
PWR TELESCOPE & TILT #1,2
THEFT ALARM
EXPRESS WINDOWS
REV MIRROR TILT
FUEL PUMP
VOICE REC. SYSTEM
CELLULAR PHONE
VEHICLE WIRING / MULTIPLEX BUS
ALPHA-NUMERIC DISPLAY
READ BUTTON
TRANSMIT BUTTON
MICRO-CONTROLLER (WITH NVM)
MC68HC05
MUX
DATA
DEMODUL.
2ND MIXER
2ND LOCAL OSCILL.
BPF
AMP/ BUFF
1ST IF AMP
1ST MIXER
1ST LOCAL OSCILL.
LOW NOISE AMP
2ND IF AMP
POWER CONTROL
POWER SUPPLY
5VDC
12VDC
BATTERY
GROUND
RF RECEIVER SECTION
30
32
34
35
40
41
42
43
44
45
47
50
51
52
53
54
55
57
58
59
60
61
62
63
64
21
22
23
24
25
27

Fig. 3

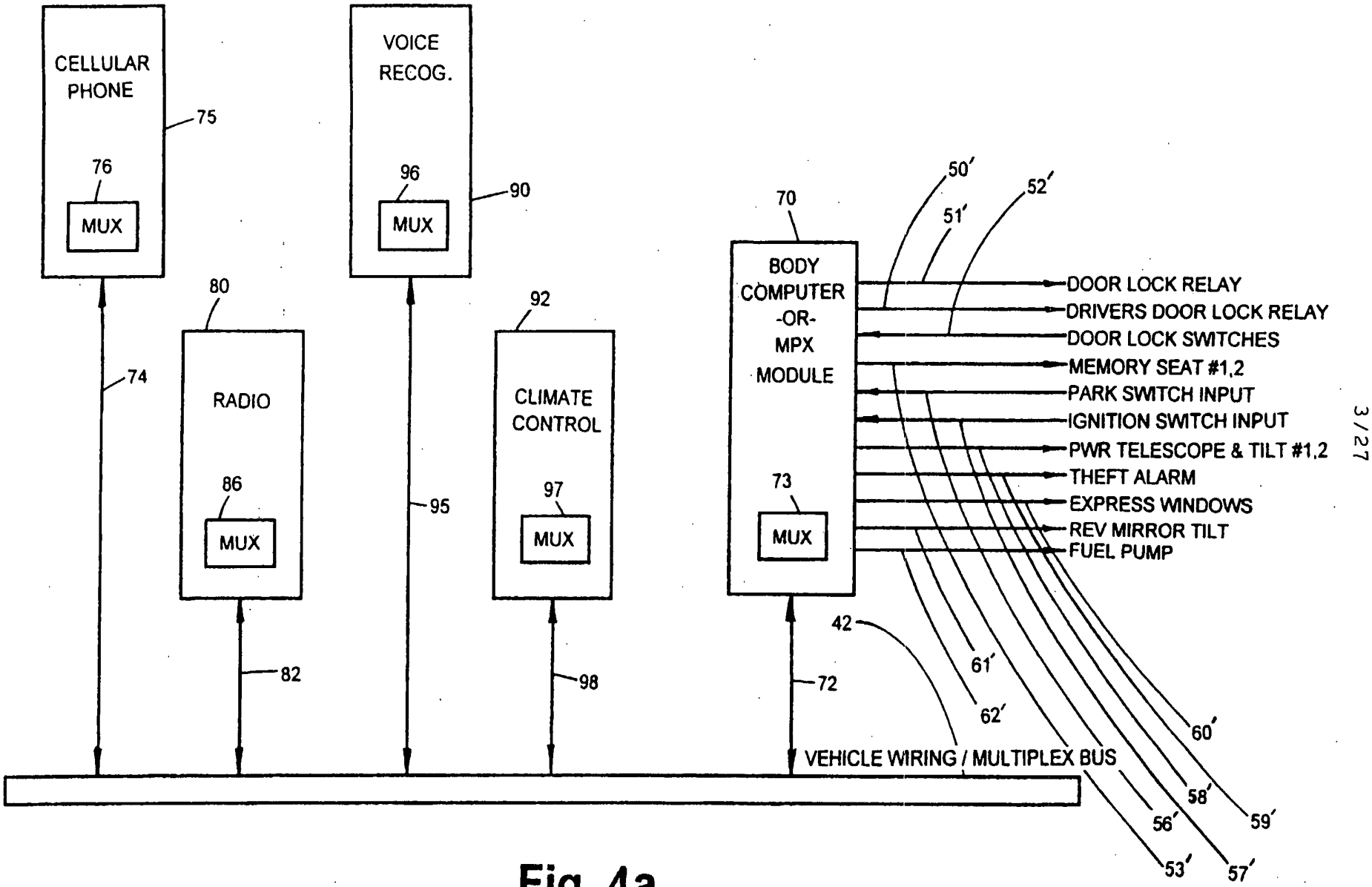

CELLULAR PHONE
75
76
MUX
VOICE RECOG.
96
MUX
90
70
BODY COMPUTER -OR- MPX MODULE
73
MUX
50′
51′
52′
DOOR LOCK RELAY
DRIVERS DOOR LOCK RELAY
DOOR LOCK SWITCHES
MEMORY SEAT #1,2
PARK SWITCH INPUT
IGNITION SWITCH INPUT
PWR TELESCOPE & TILT #1,2
THEFT ALARM
EXPRESS WINDOWS
REV MIRROR TILT
FUEL PUMP
80
RADIO
86
MUX
92
CLIMATE CONTROL
97
MUX
74
82
95
98
72
42
61′
62′
60′
58′
56′
59′
53′
57′
VEHICLE WIRING / MULTIPLEX BUS

Fig. 4a

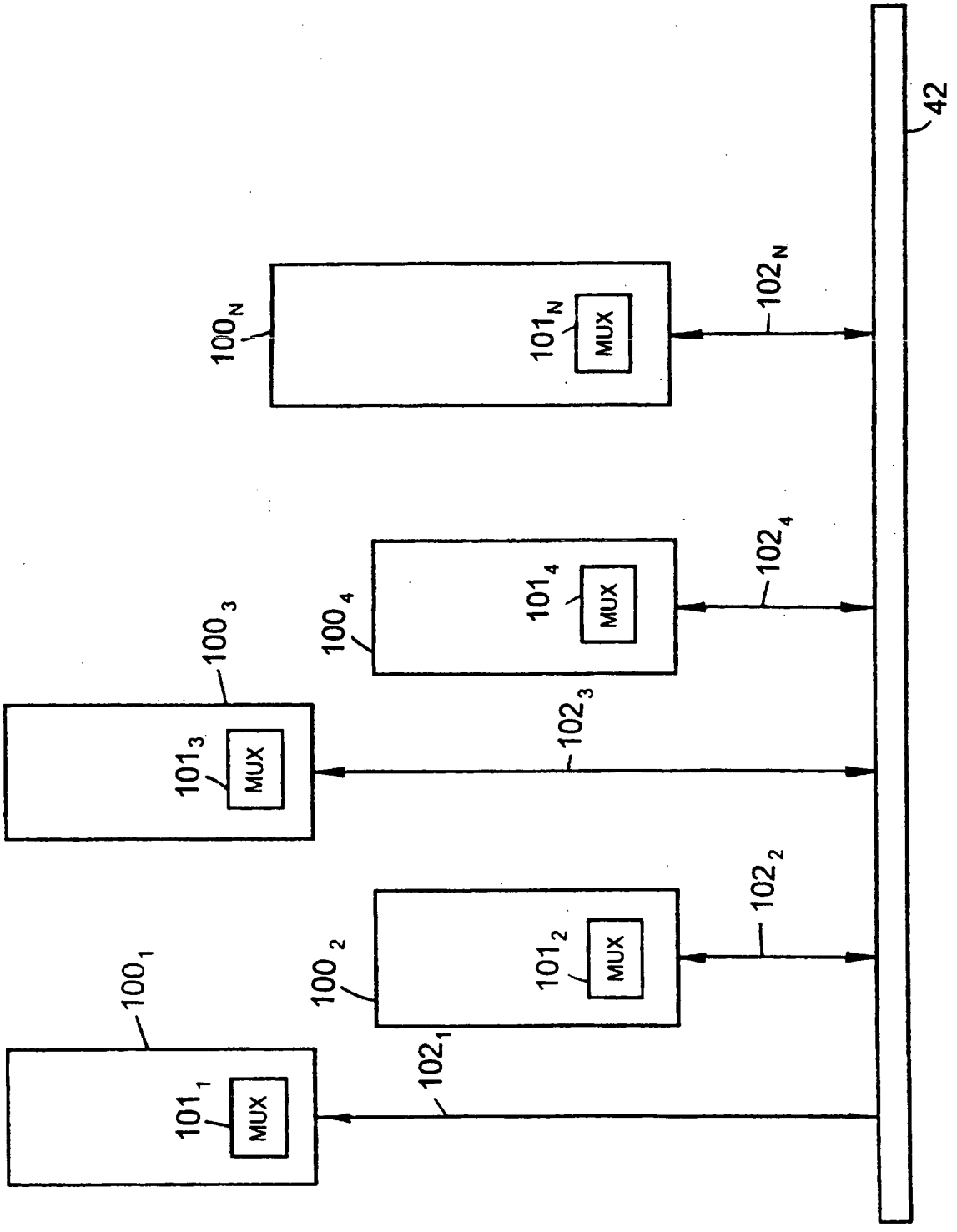

42
100N
101N
MUX
102N
100 4
101 4
MUX
102 4
100 3
101 3
MUX
102 3
100 2
101 2
MUX
102 2
100 1
101 1
MUX
102 1

Fig. 4b

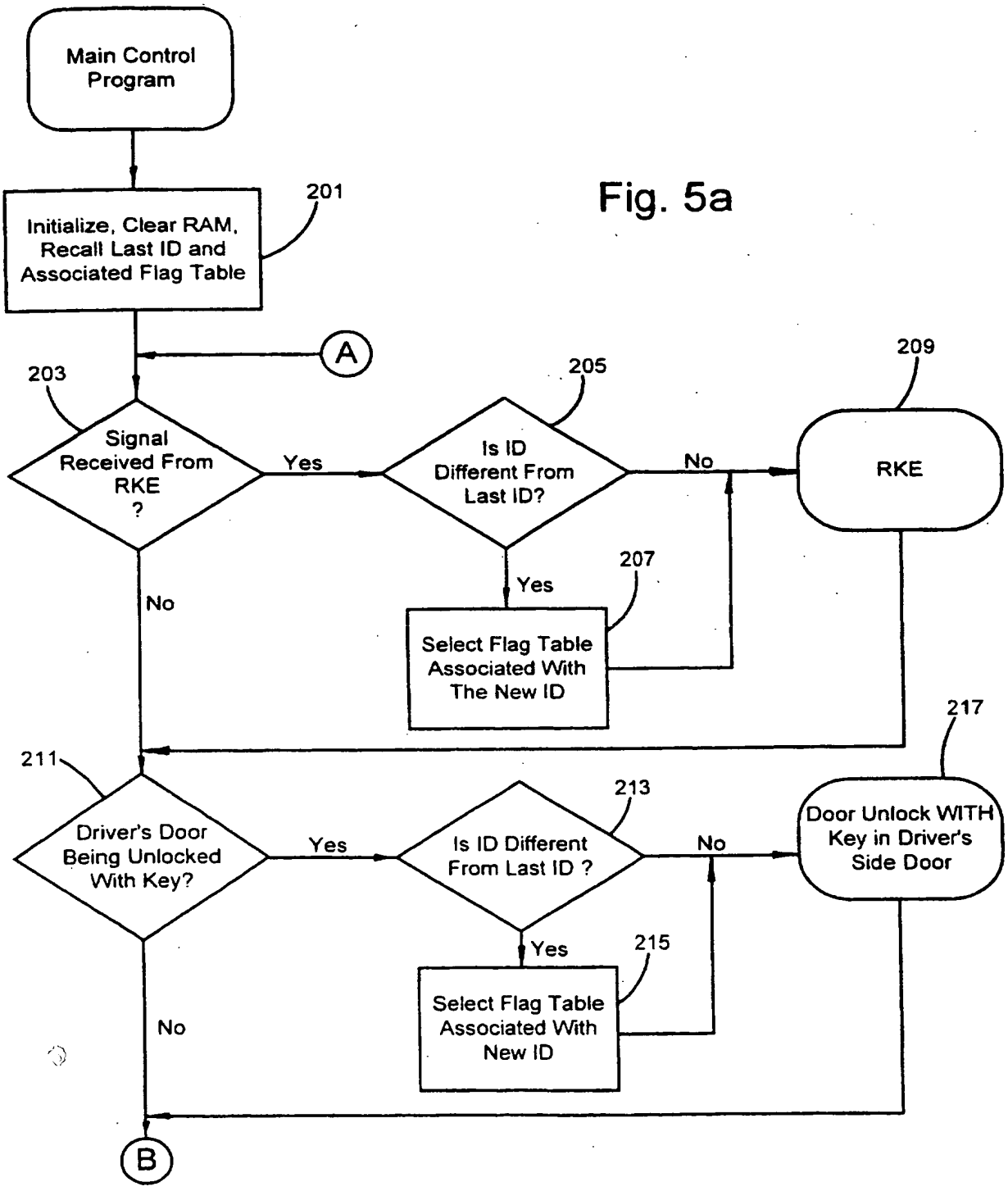

Main Control Program
Initialize, Clear RAM, Recall Last ID and Associated Flag Table
201
A
203
Signal Received From RKE ?
Yes
205
Is ID Different From Last ID?
No
209
RKE
No
Yes
207
Select Flag Table Associated With The New ID
217
211
Driver's Door Being Unlocked With Key?
Yes
213
Is ID Different From Last ID ?
No
Door Unlock WITH Key in Driver's Side Door
Yes
215
Select Flag Table Associated With New ID
No
B

Fig. 5a

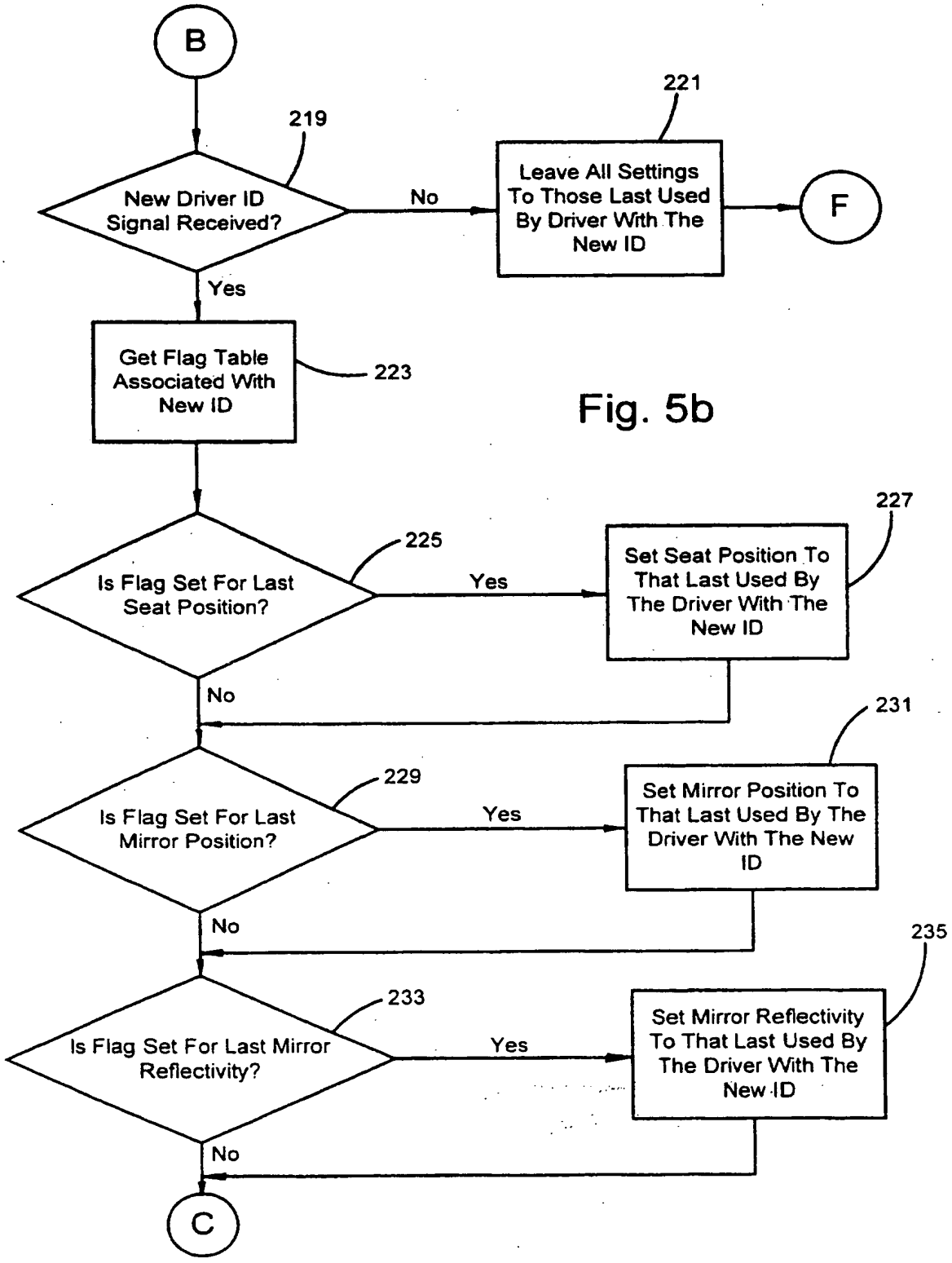
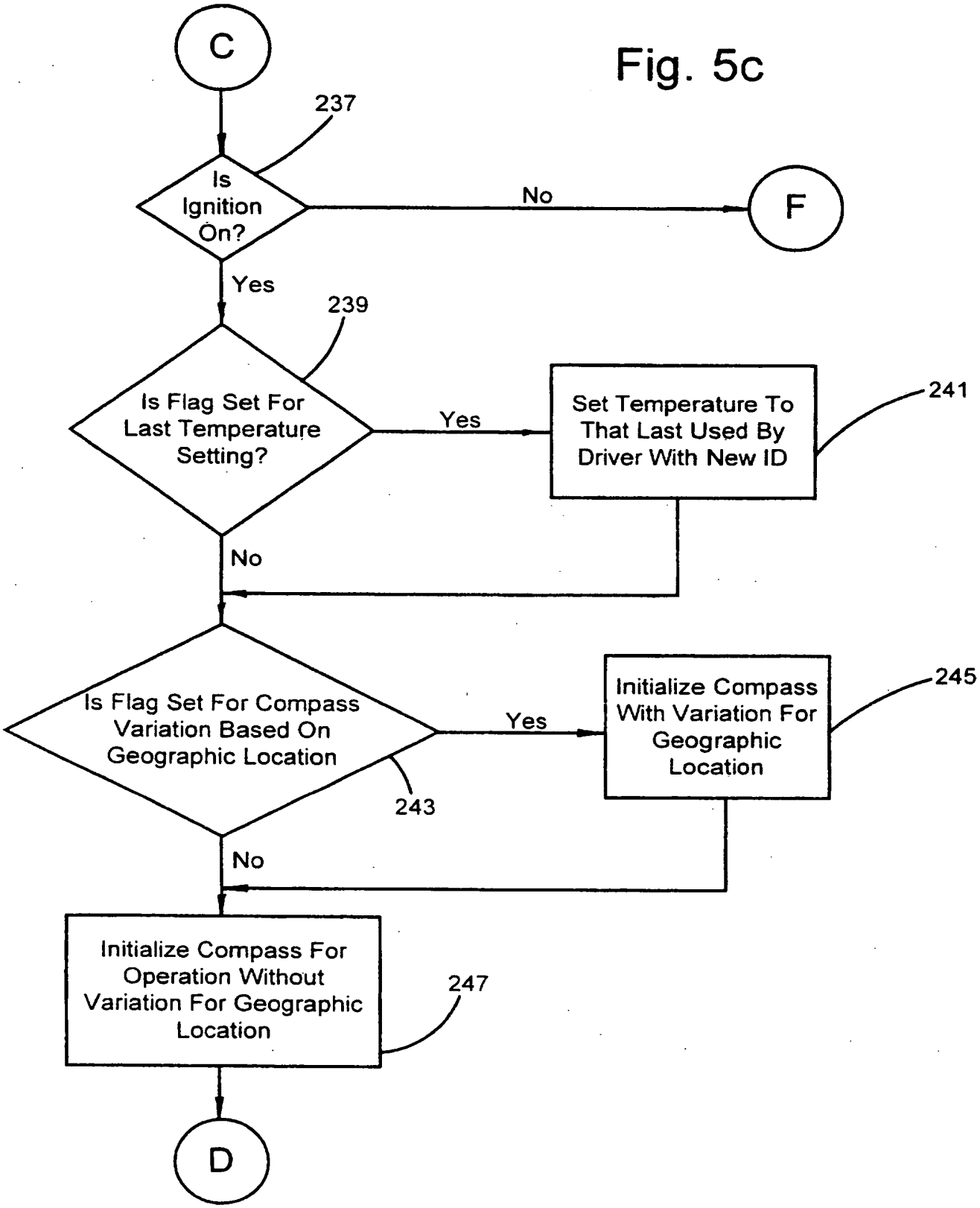

B
219
New Driver ID Signal Received?
No
221
Leave All Settings To Those Last Used By Driver With The New ID
F
Yes
Get Flag Table Associated With New ID
223
225
Is Flag Set For Last Seat Position?
Yes
227
Set Seat Position To That Last Used By The Driver With The New ID
No
231
229
Is Flag Set For Last Mirror Position?
Yes
Set Mirror Position To That Last Used By The Driver With The New ID
No
235
233
Is Flag Set For Last Mirror Reflectivity?
Yes
Set Mirror Reflectivity To That Last Used By The Driver With The New ID
No
C

Fig. 5b

Fig. 5c


C
237
Is Ignition On?
No
F
Yes
239
Is Flag Set For Last Temperature Setting?
Yes
Set Temperature To That Last Used By Driver With New ID
241
No
Is Flag Set For Compass Variation Based On Geographic Location
Yes
Initialize Compass With Variation For Geographic Location
245
243
No
Initialize Compass For Operation Without Variation For Geographic Location
247
D

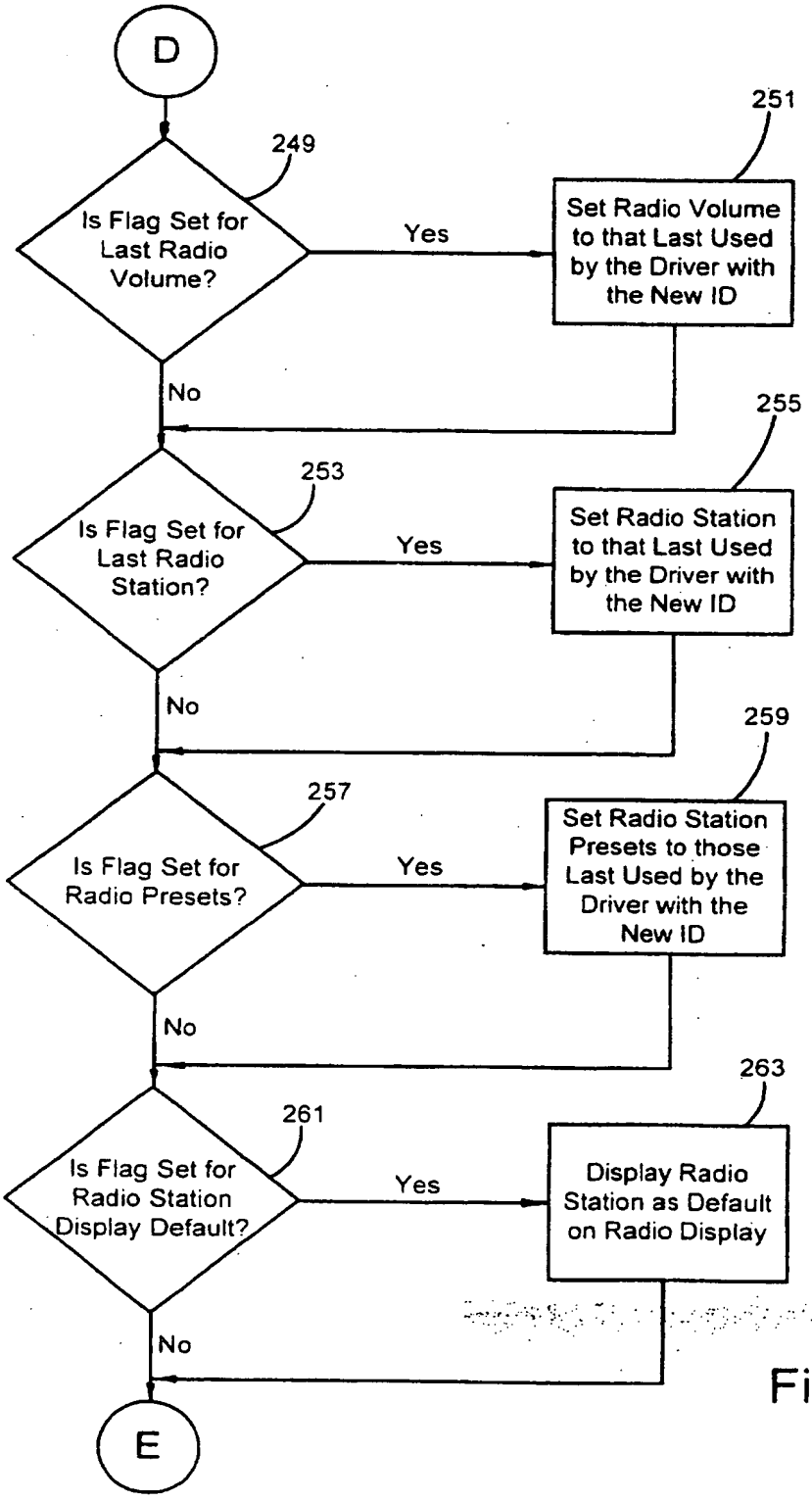

D
249
Is Flag Set for Last Radio Volume?
Yes
251
Set Radio Volume to that Last Used by the Driver with the New ID
No
253
Is Flag Set for Last Radio Station?
Yes
255
Set Radio Station to that Last Used by the Driver with the New ID
No
257
Is Flag Set for Radio Presets?
Yes
259
Set Radio Station Presets to those Last Used by the Driver with the New ID
No
261
Is Flag Set for Radio Station Display Default?
Yes
263
Display Radio Station as Default on Radio Display
No
E

Fig. 5d

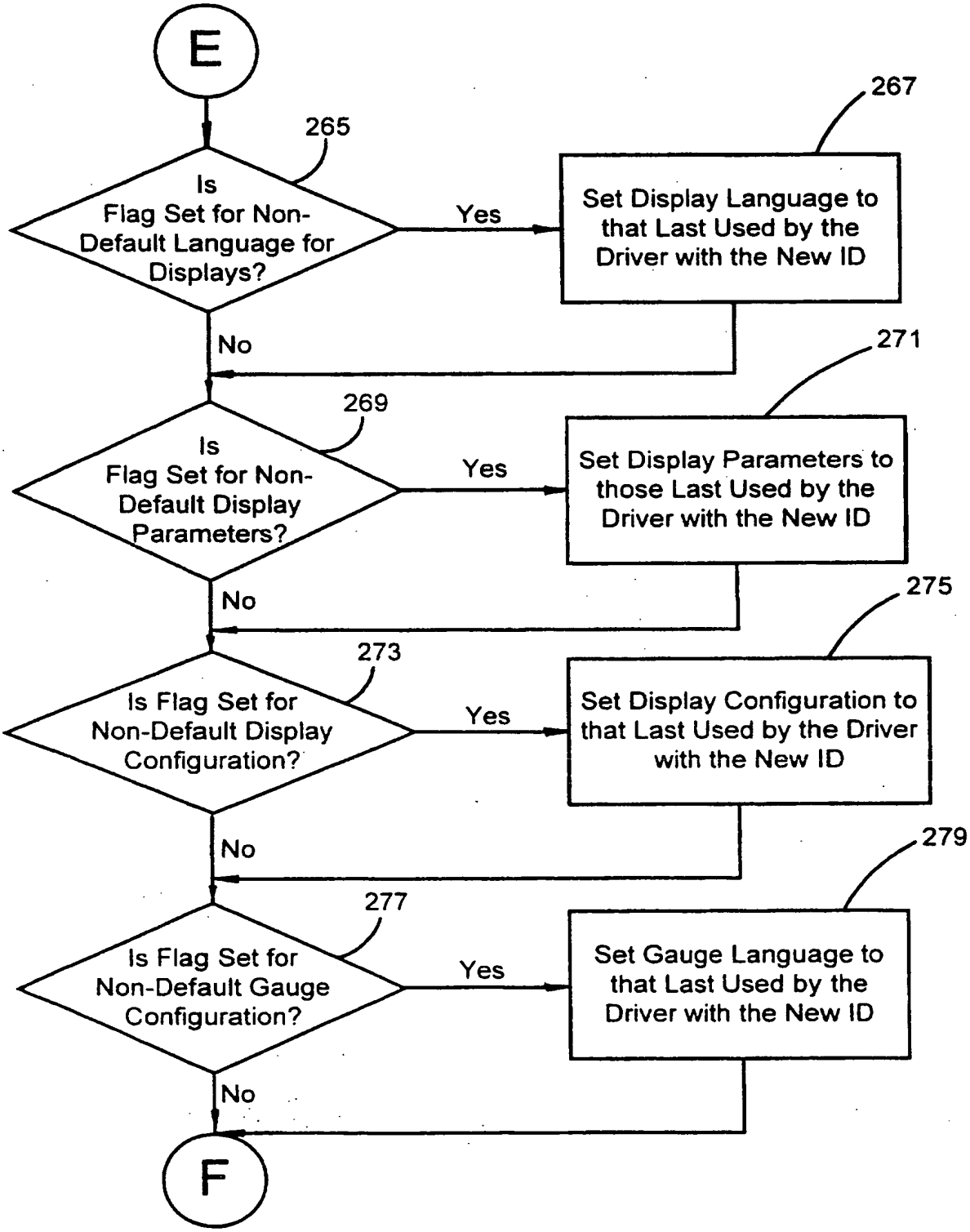

E
265
Is Flag Set for Non-Default Language for Displays?
Yes
267
Set Display Language to that Last Used by the Driver with the New ID
No
269
Is Flag Set for Non-Default Display Parameters?
Yes
271
Set Display Parameters to those Last Used by the Driver with the New ID
No
273
Is Flag Set for Non-Default Display Configuration?
Yes
275
Set Display Configuration to that Last Used by the Driver with the New ID
No
277
Is Flag Set for Non-Default Gauge Configuration?
Yes
279
Set Gauge Language to that Last Used by the Driver with the New ID
No
F

Fig. 5e

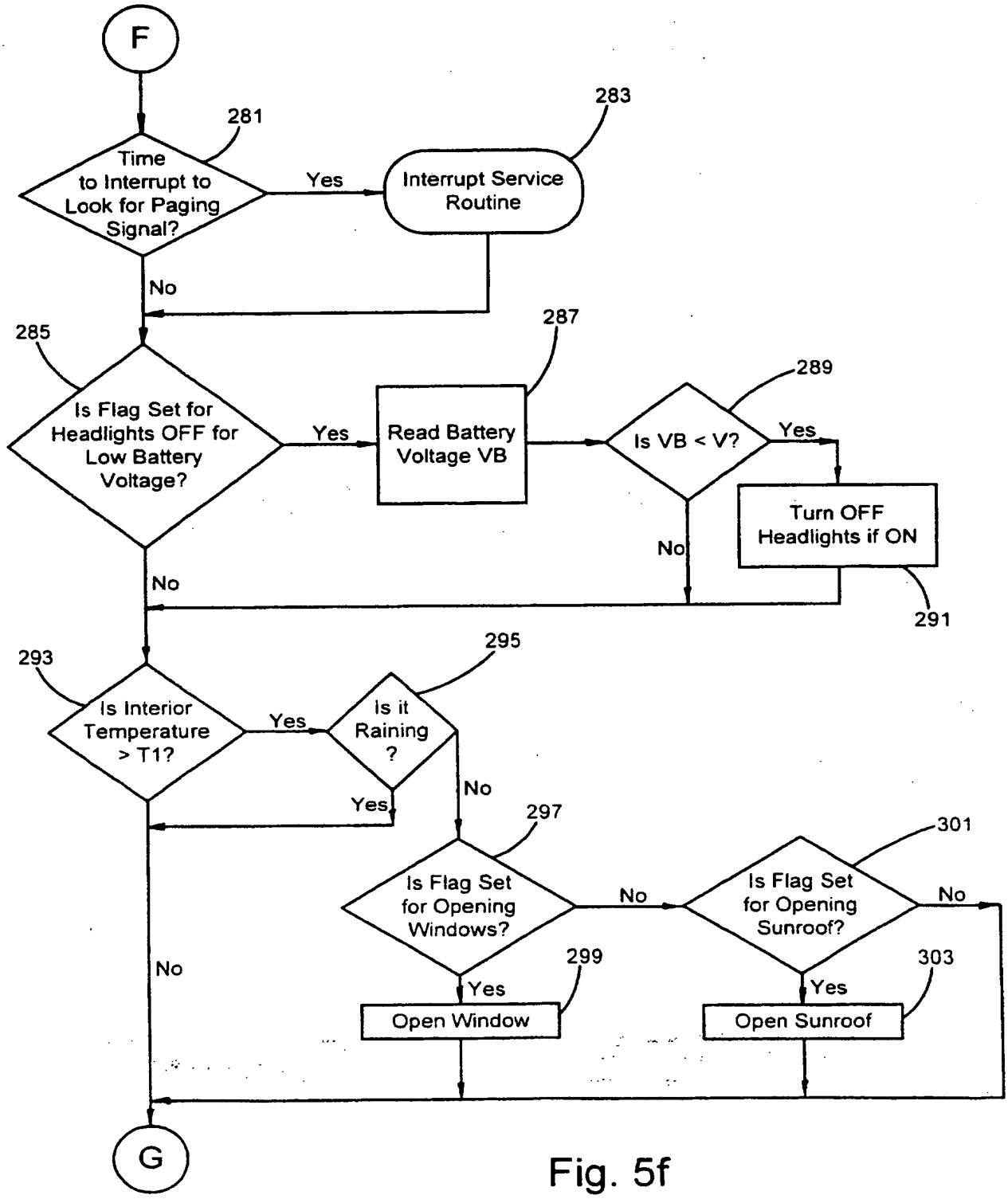

F
281
Time to Interrupt to Look for Paging Signal?
Yes
283
Interrupt Service Routine
No
285
Is Flag Set for Headlights OFF for Low Battery Voltage?
Yes
287
Read Battery Voltage VB
289
Is VB < V?
Yes
Turn OFF Headlights if ON
No
No
291
293
Is Interior Temperature > T1?
Yes
295
Is it Raining ?
Yes
No
297
Is Flag Set for Opening Windows?
No
301
Is Flag Set for Opening Sunroof?
No
No
299
Yes
Open Window
303
Yes
Open Sunroof
G

Fig. 5f

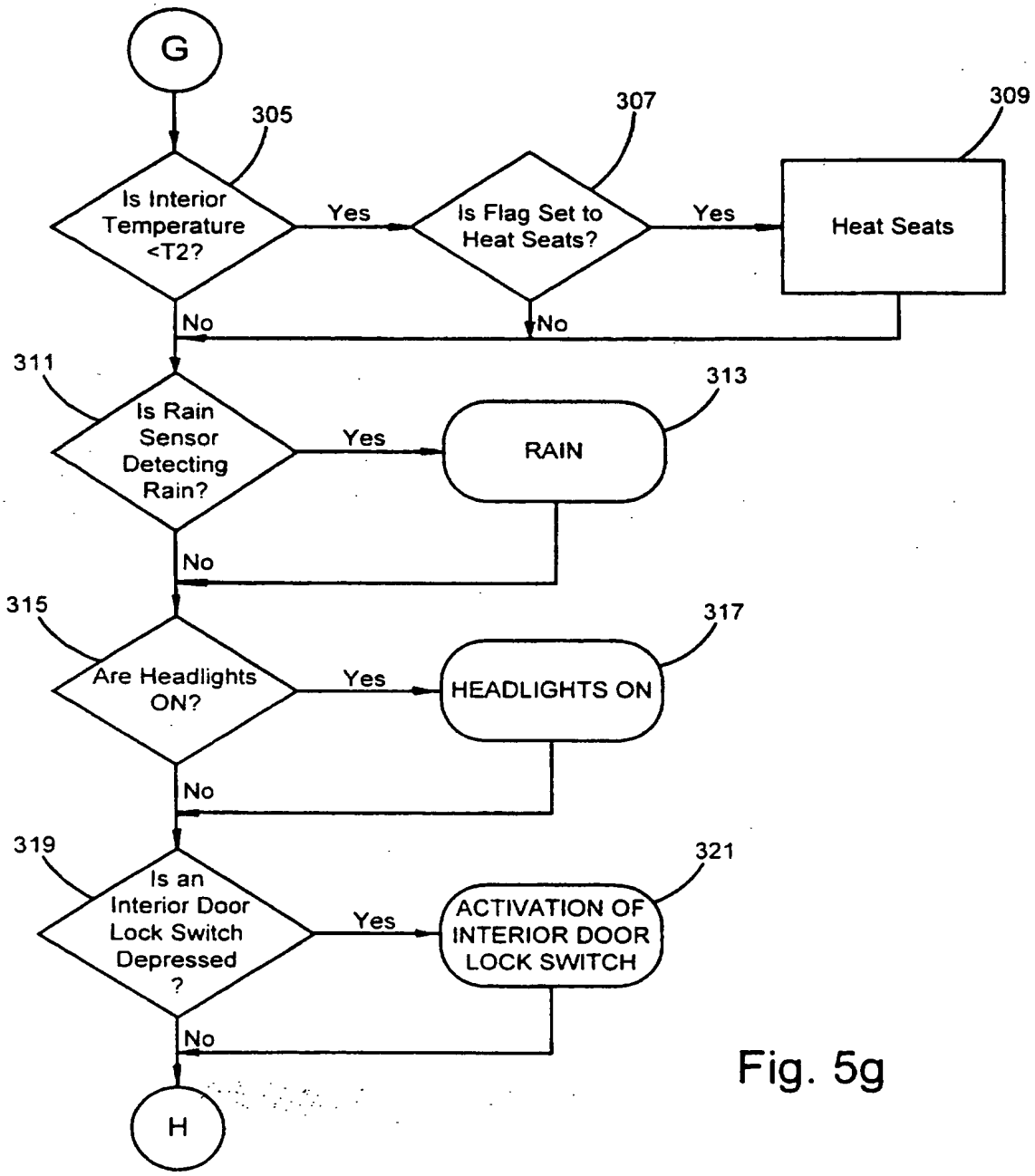

G
305
Is Interior Temperature <T2?
Yes
307
Is Flag Set to Heat Seats?
Yes
309
Heat Seats
No
No
311
Is Rain Sensor Detecting Rain?
Yes
313
RAIN
No
315
Are Headlights ON?
Yes
317
HEADLIGHTS ON
No
319
Is an Interior Door Lock Switch Depressed ?
Yes
321
ACTIVATION OF INTERIOR DOOR LOCK SWITCH
No
H

Fig. 5g

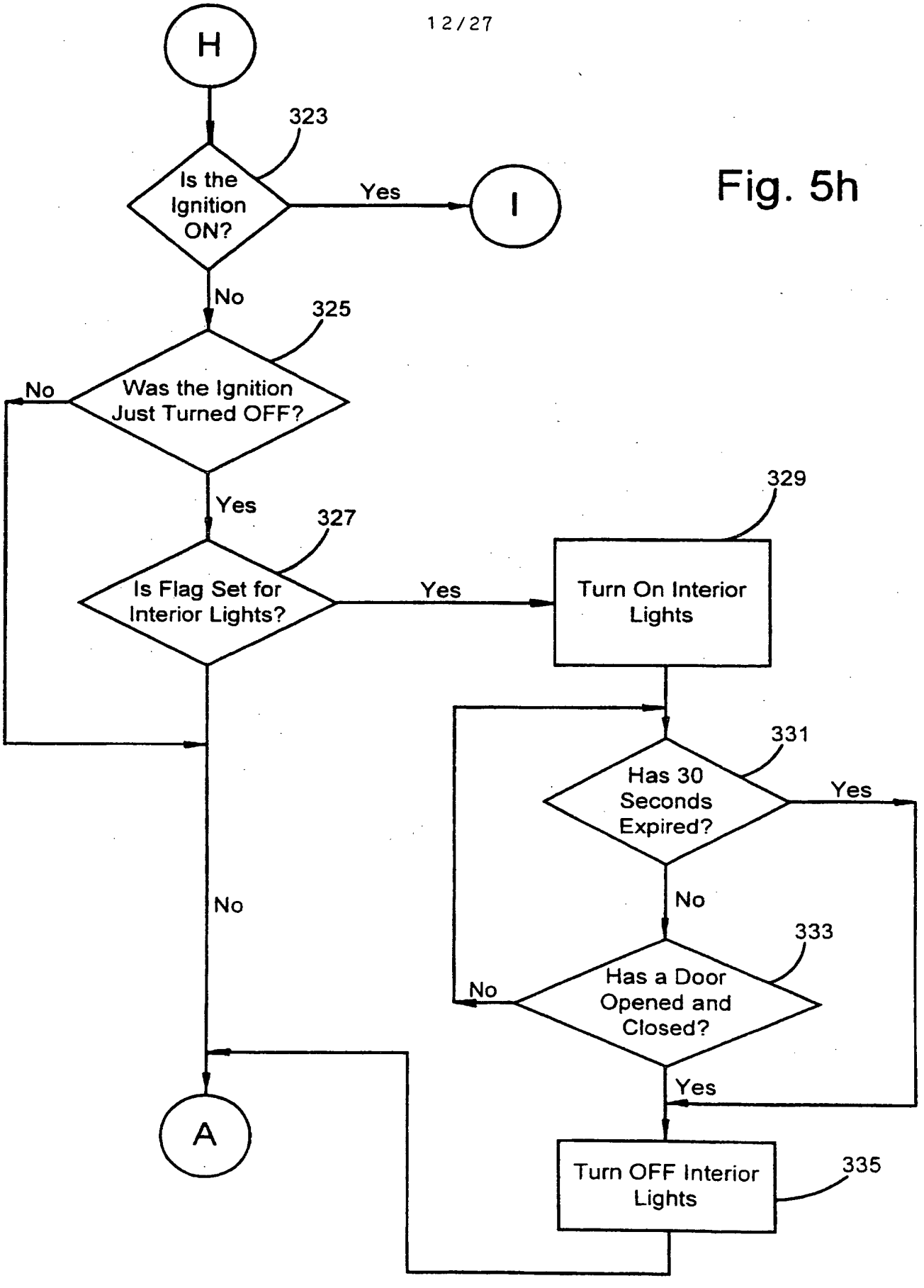

H
323
Is the Ignition ON?
Yes
I
No
325
Was the Ignition Just Turned OFF?
No
Yes
327
Is Flag Set for Interior Lights?
Yes
329
Turn On Interior Lights
331
Has 30 Seconds Expired?
Yes
No
333
Has a Door Opened and Closed?
No
Yes
Turn OFF Interior Lights
335
No
A

Fig. 5h

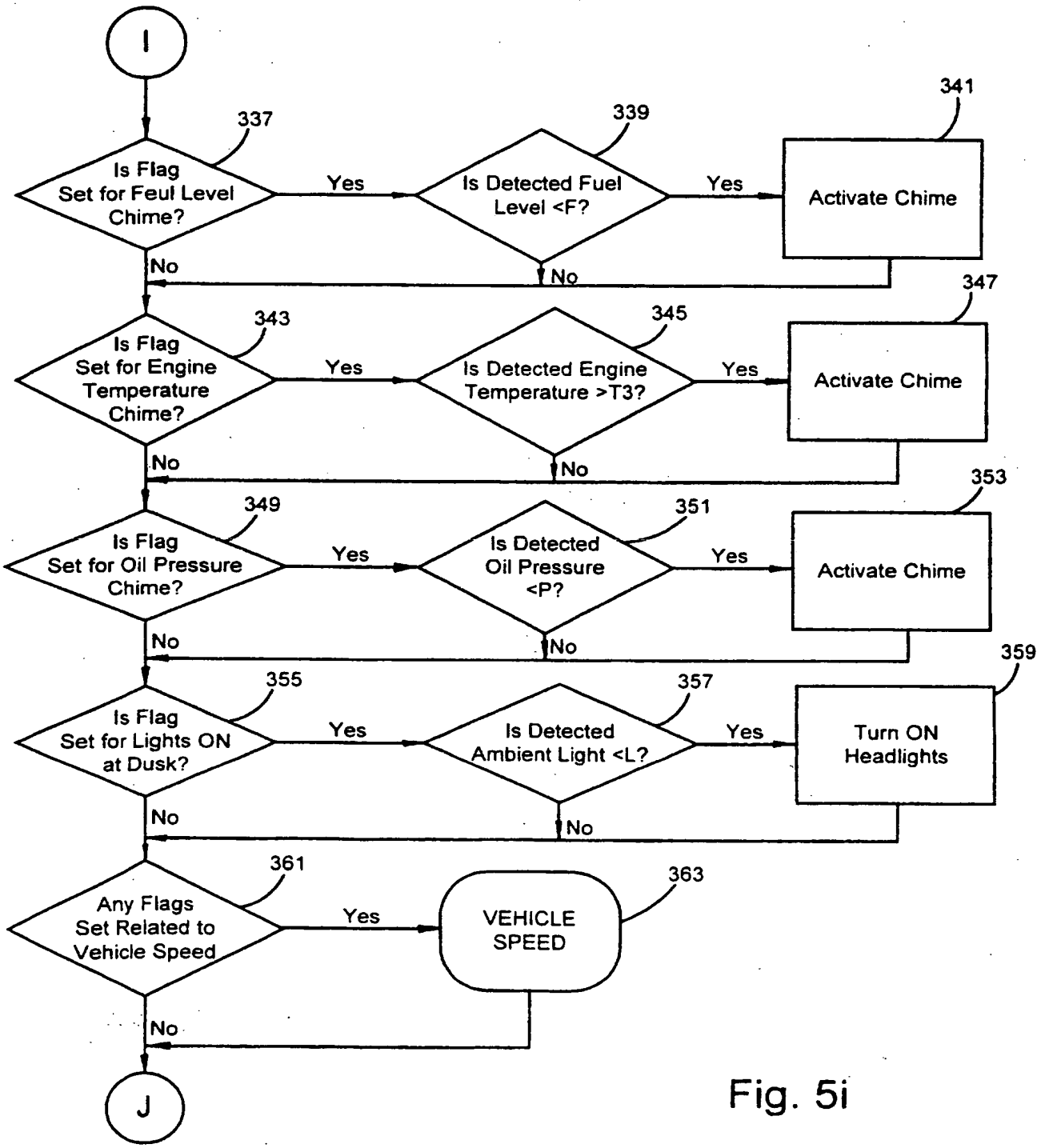

I
337
Is Flag Set for Feul Level Chime?
Yes
339
Is Detected Fuel Level <F?
Yes
341
Activate Chime
No
No
343
Is Flag Set for Engine Temperature Chime?
Yes
345
Is Detected Engine Temperature >T3?
Yes
347
Activate Chime
No
No
349
Is Flag Set for Oil Pressure Chime?
Yes
351
Is Detected Oil Pressure <P?
Yes
353
Activate Chime
No
No
355
Is Flag Set for Lights ON at Dusk?
Yes
357
Is Detected Ambient Light <L?
Yes
359
Turn ON Headlights
No
No
361
Any Flags Set Related to Vehicle Speed
Yes
363
VEHICLE SPEED
No
J

Fig. 5i

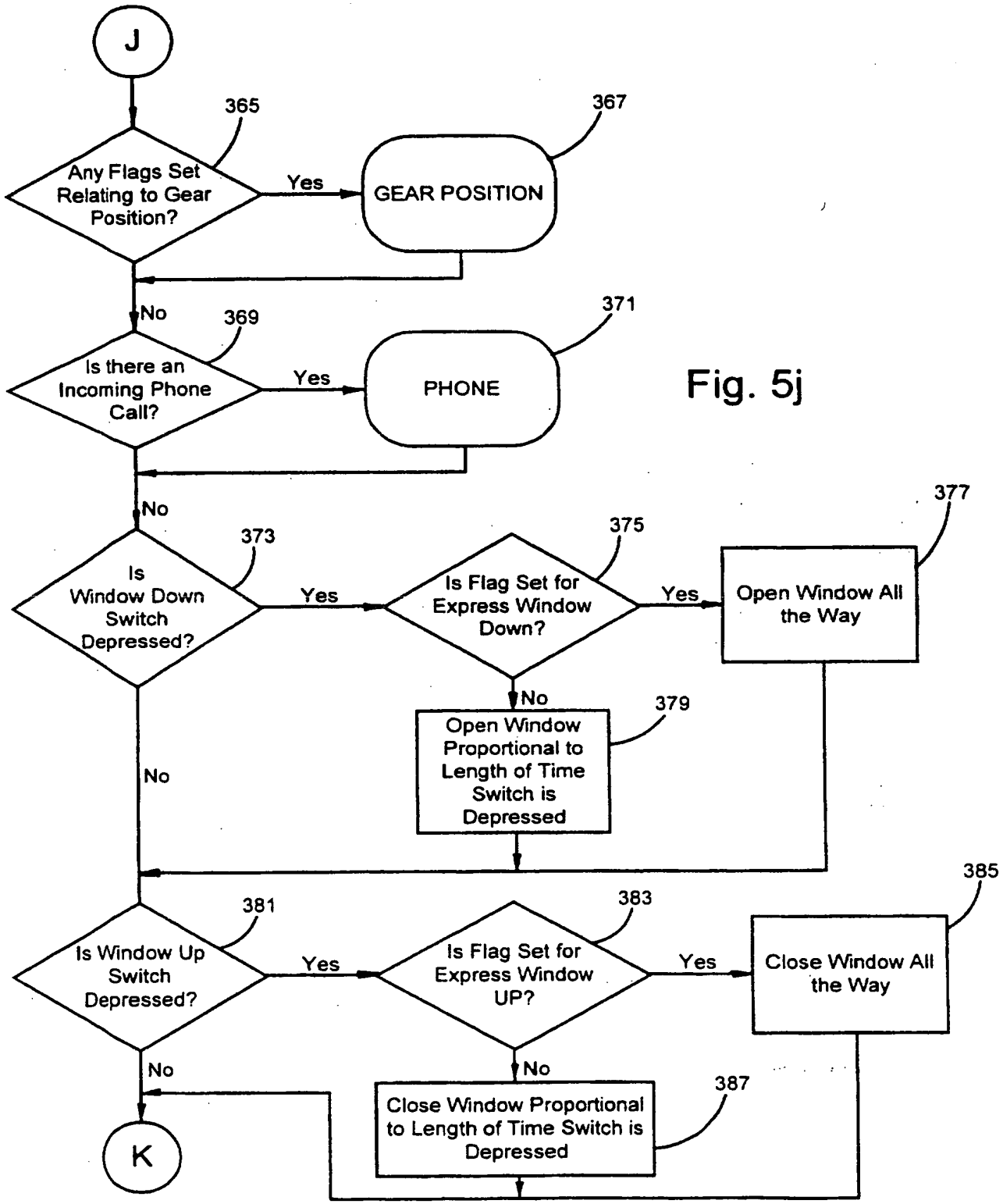

J
365
Any Flags Set Relating to Gear Position?
Yes
367
GEAR POSITION
No
369
Is there an Incoming Phone Call?
Yes
371
PHONE
No
373
Is Window Down Switch Depressed?
Yes
375
Is Flag Set for Express Window Down?
Yes
377
Open Window All the Way
No
379
Open Window Proportional to Length of Time Switch is Depressed
No
381
Is Window Up Switch Depressed?
Yes
383
Is Flag Set for Express Window UP?
Yes
385
Close Window All the Way
No
387
Close Window Proportional to Length of Time Switch is Depressed
No
K

Fig. 5j

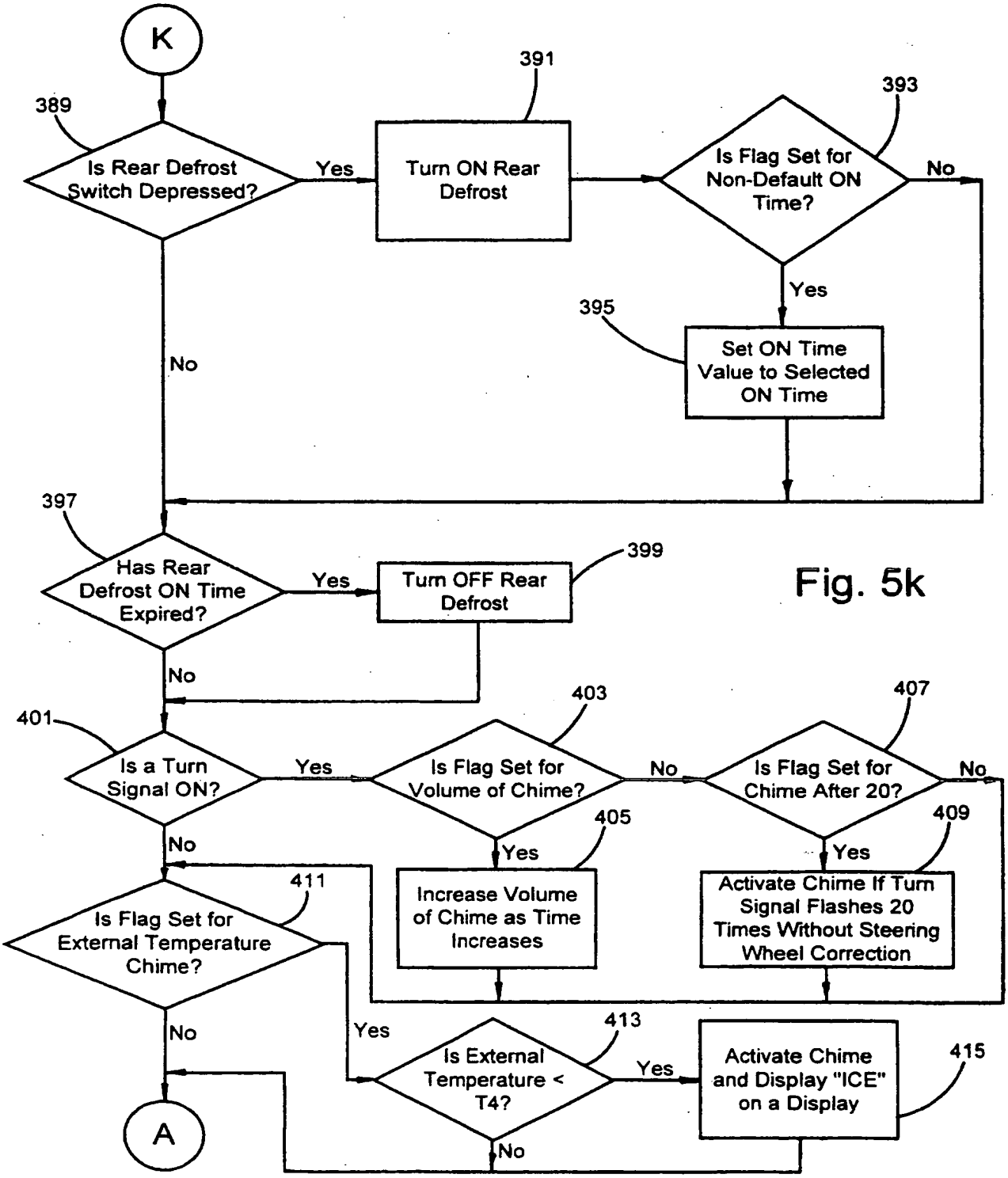

K
389
Is Rear Defrost Switch Depressed?
Yes
391
Turn ON Rear Defrost
393
Is Flag Set for Non-Default ON Time?
No
Yes
395
Set ON Time Value to Selected ON Time
No
397
Has Rear Defrost ON Time Expired?
Yes
399
Turn OFF Rear Defrost
No
401
Is a Turn Signal ON?
Yes
403
Is Flag Set for Volume of Chime?
No
407
Is Flag Set for Chime After 20?
No
No
Yes
405
Increase Volume of Chime as Time Increases
Yes
409
Activate Chime If Turn Signal Flashes 20 Times Without Steering Wheel Correction
411
Is Flag Set for External Temperature Chime?
No
Yes
413
Is External Temperature < T4?
Yes
415
Activate Chime and Display "ICE" on a Display
No
A

Fig. 5k

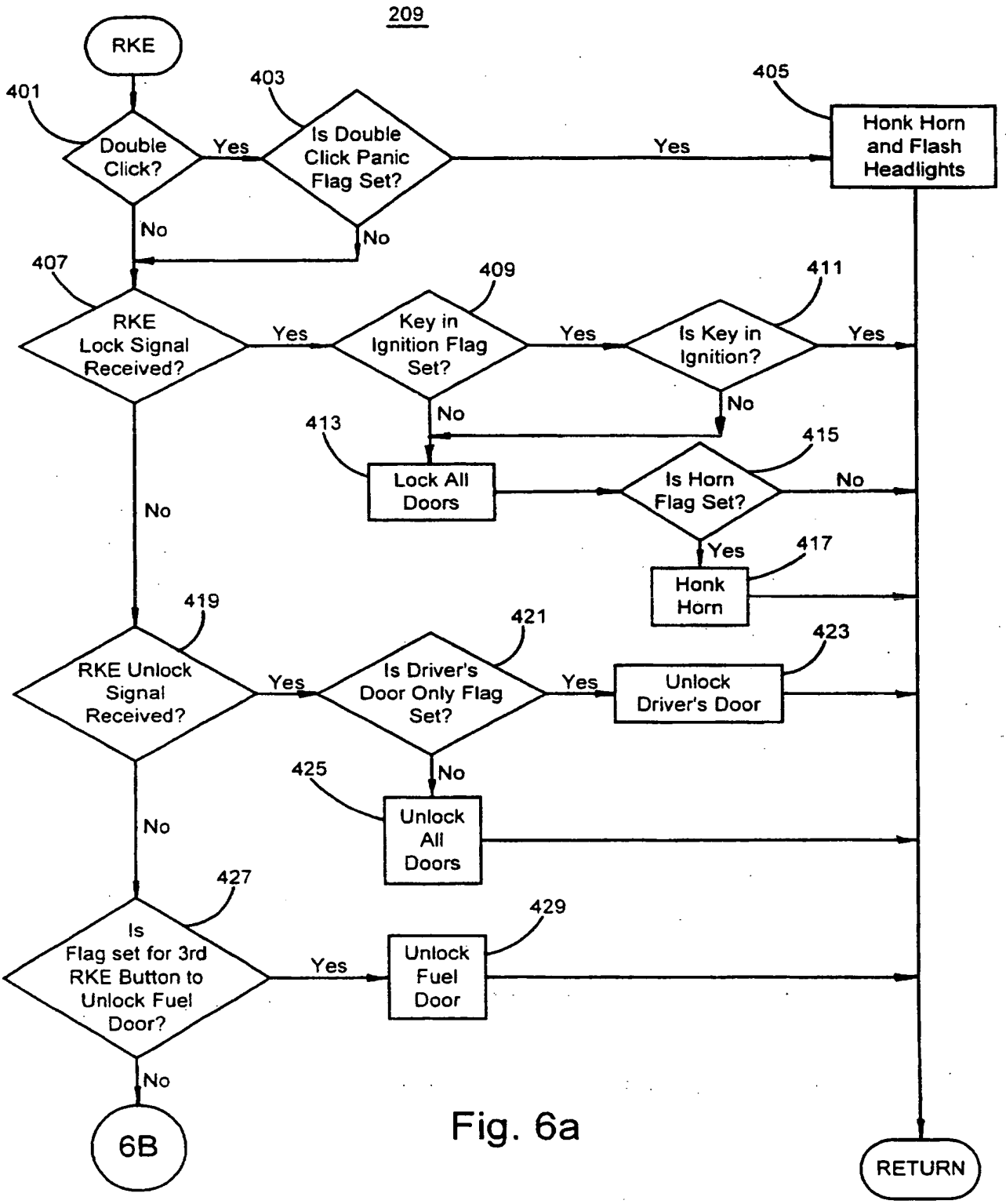

209
RKE
401
Double Click?
Yes
403
Is Double Click Panic Flag Set?
Yes
405
Honk Horn and Flash Headlights
No
No
407
RKE Lock Signal Received?
Yes
409
Key in Ignition Flag Set?
Yes
411
Is Key in Ignition?
Yes
No
No
413
Lock All Doors
415
Is Horn Flag Set?
No
No
Yes
417
Honk Horn
419
RKE Unlock Signal Received?
Yes
421
Is Driver's Door Only Flag Set?
Yes
423
Unlock Driver's Door
No
425
Unlock All Doors
No
427
Is Flag set for 3rd RKE Button to Unlock Fuel Door?
Yes
429
Unlock Fuel Door
No
6B
RETURN

Fig. 6a

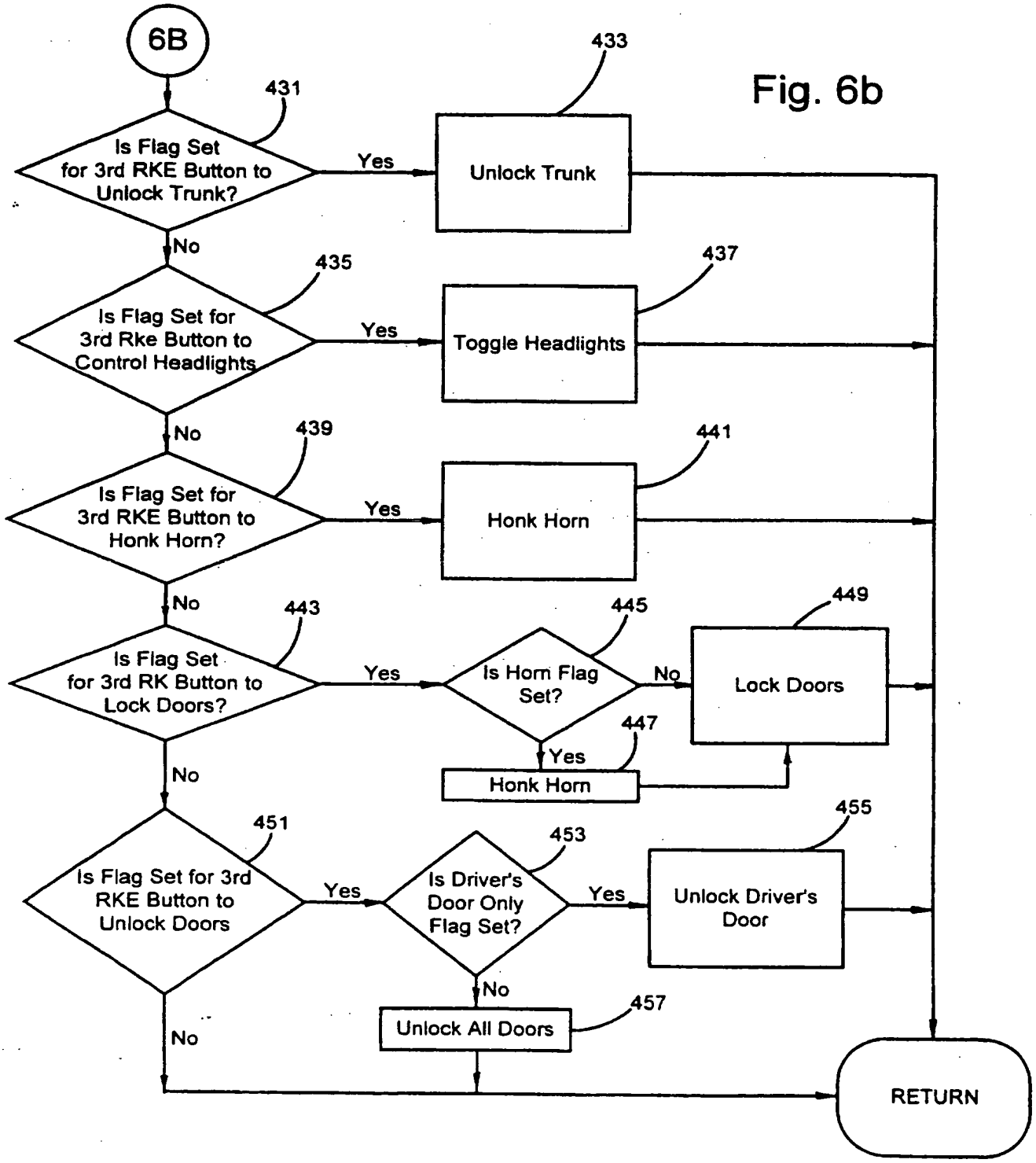

6B
431
Is Flag Set for 3rd RKE Button to Unlock Trunk?
Yes
433
Unlock Trunk
No
435
Is Flag Set for 3rd Rke Button to Control Headlights
Yes
437
Toggle Headlights
No
439
Is Flag Set for 3rd RKE Button to Honk Horn?
Yes
441
Honk Horn
No
443
Is Flag Set for 3rd RK Button to Lock Doors?
Yes
445
Is Horn Flag Set?
No
449
Lock Doors
Yes
447
Honk Horn
No
451
Is Flag Set for 3rd RKE Button to Unlock Doors
Yes
453
Is Driver's Door Only Flag Set?
Yes
455
Unlock Driver's Door
No
457
Unlock All Doors
No
RETURN

Fig. 6b

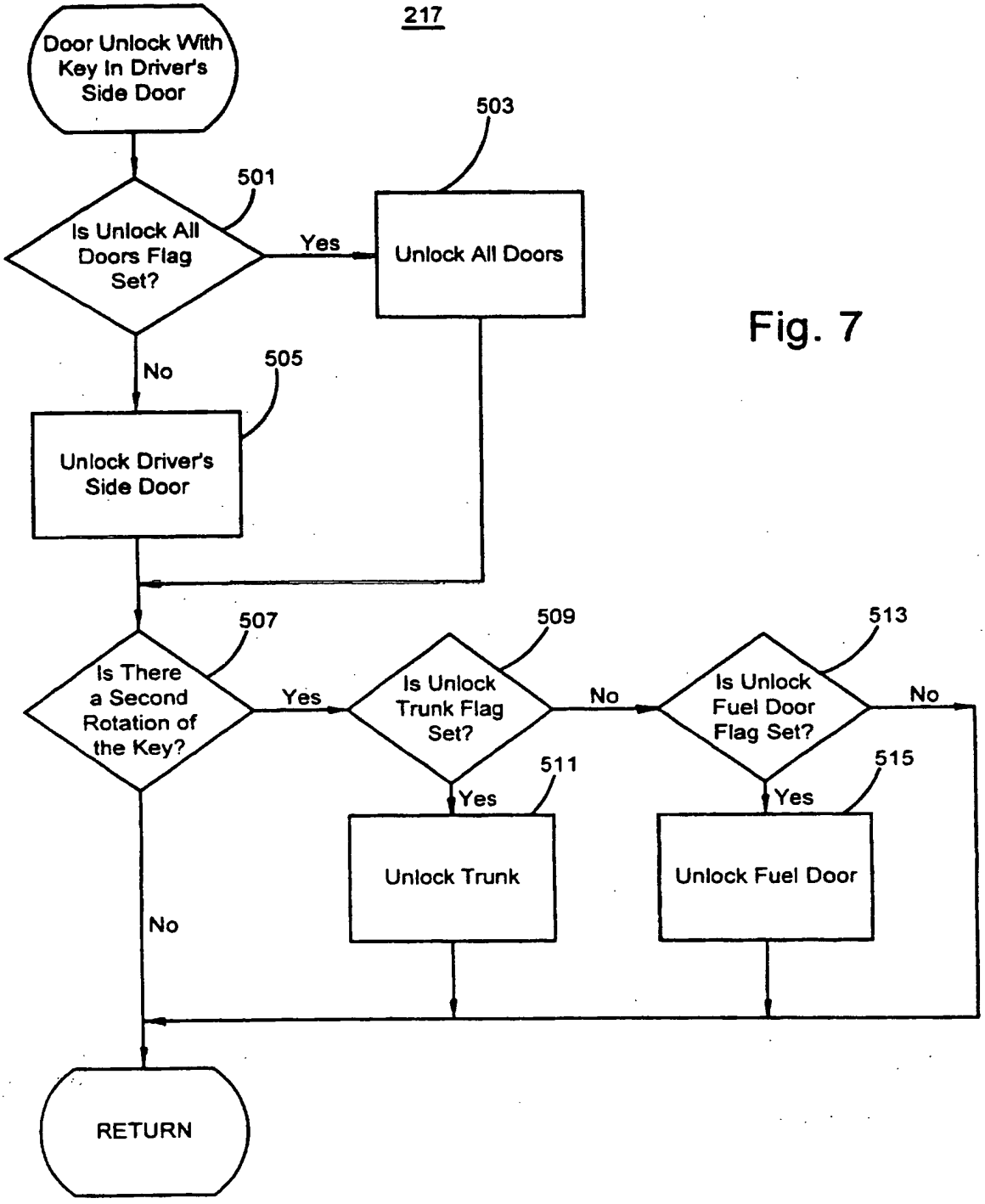

217
Door Unlock With Key In Driver's Side Door
501
Is Unlock All Doors Flag Set?
Yes
503
Unlock All Doors
No
505
Unlock Driver's Side Door
507
Is There a Second Rotation of the Key?
Yes
509
Is Unlock Trunk Flag Set?
No
513
Is Unlock Fuel Door Flag Set?
No
Yes
511
Unlock Trunk
Yes
515
Unlock Fuel Door
No
RETURN

Fig. 7

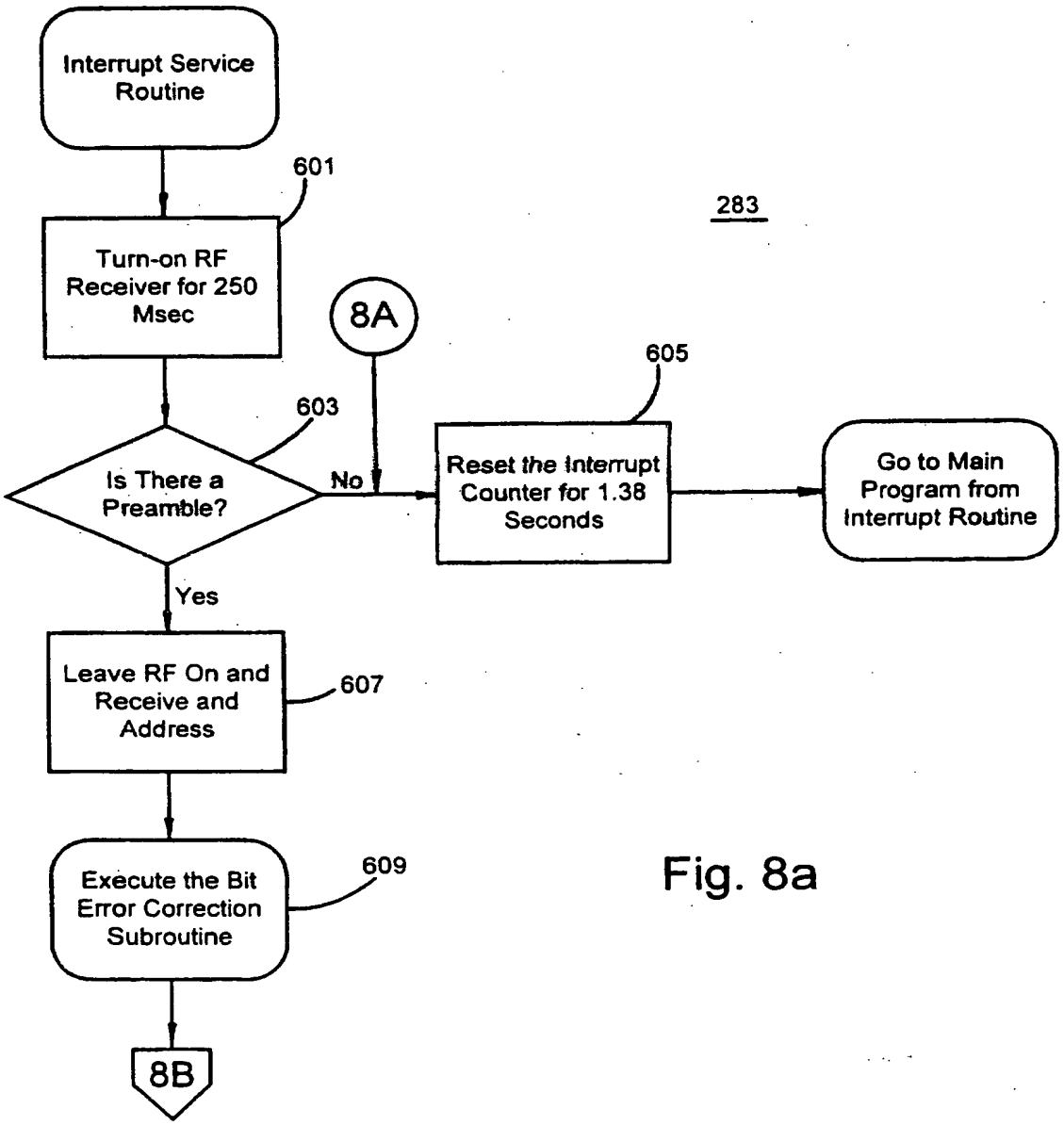

Interrupt Service Routine
601
Turn-on RF Receiver for 250 Msec
283
8A
605
603
Is There a Preamble?
No
Reset the Interrupt Counter for 1.38 Seconds
Go to Main Program from Interrupt Routine
Yes
Leave RF On and Receive and Address
607
Execute the Bit Error Correction Subroutine
609
8B

Fig. 8a

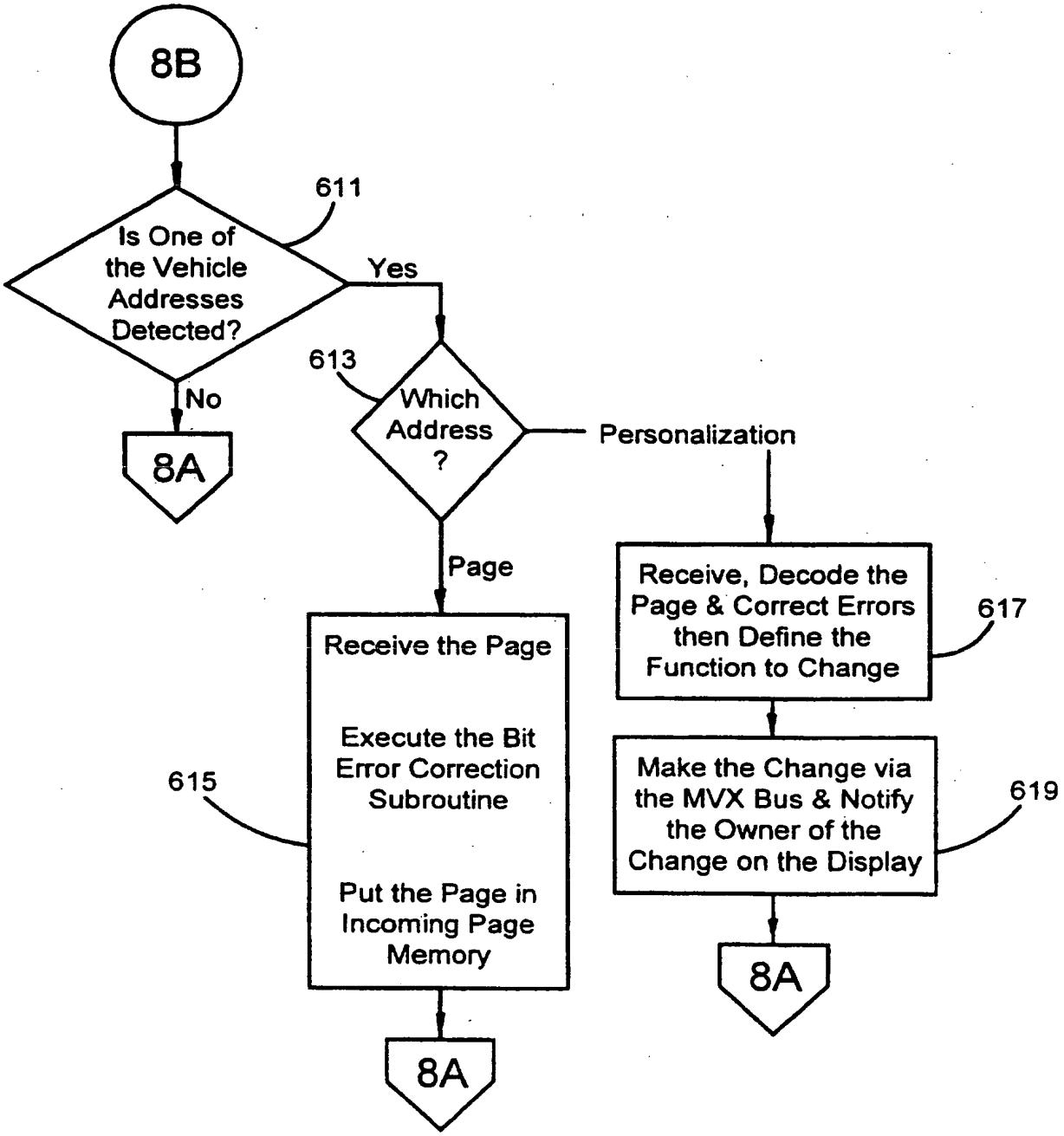

8B
611
Is One of the Vehicle Addresses Detected?
Yes
No
8A
613
Which Address ?
Personalization
Page
Receive the Page
Execute the Bit Error Correction Subroutine
Put the Page in Incoming Page Memory
615
8A
Receive, Decode the Page & Correct Errors then Define the Function to Change
617
Make the Change via the MVX Bus & Notify the Owner of the Change on the Display
619
8A

Fig. 8b

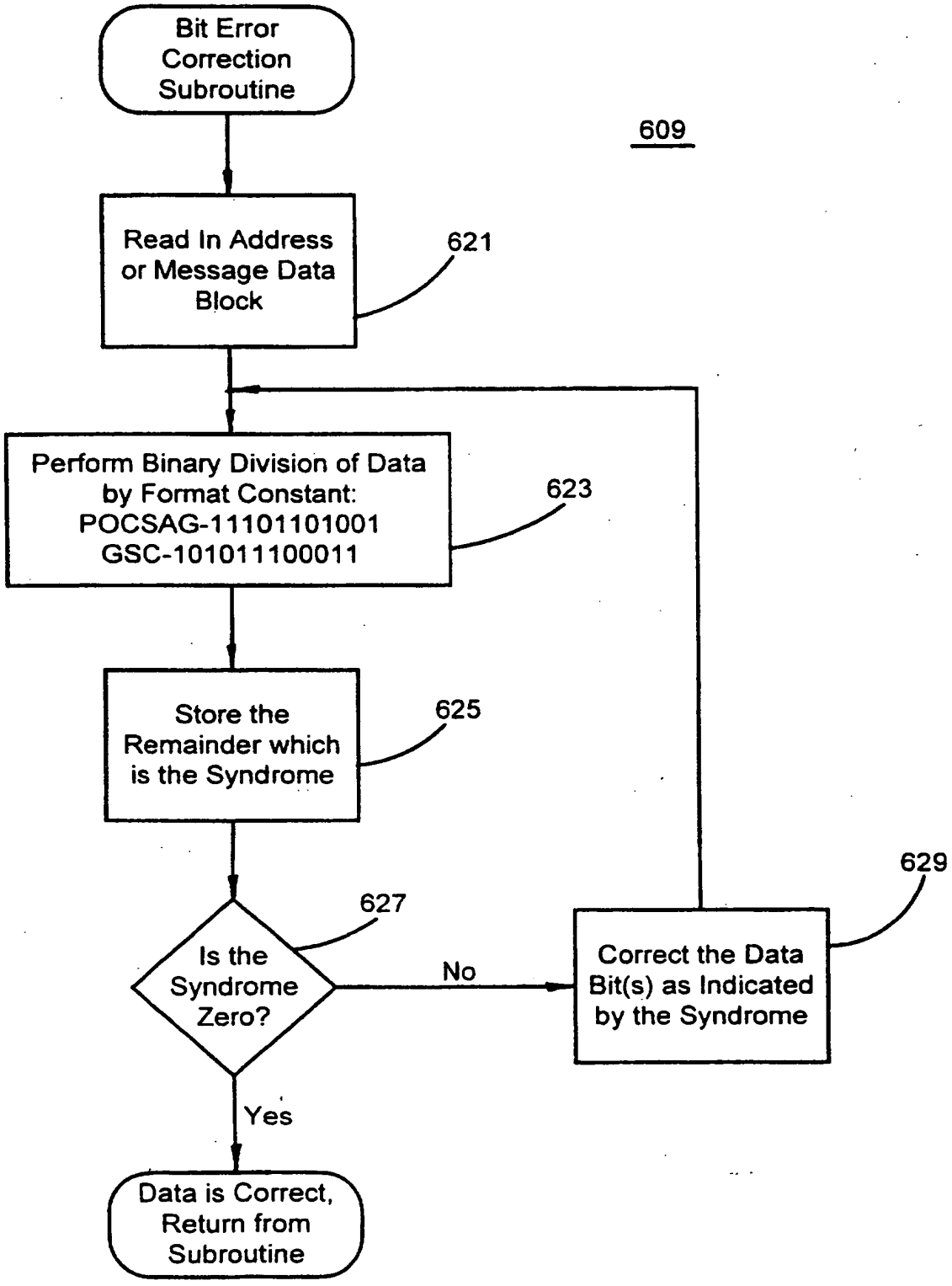

Bit Error Correction Subroutine
609
Read In Address or Message Data Block
621
Perform Binary Division of Data by Format Constant:
POCSAG-11101101001
GSC-101011100011
623
Store the Remainder which is the Syndrome
625
627
Is the Syndrome Zero?
No
Correct the Data Bit(s) as Indicated by the Syndrome
629
Yes
Data is Correct, Return from Subroutine

Fig. 9

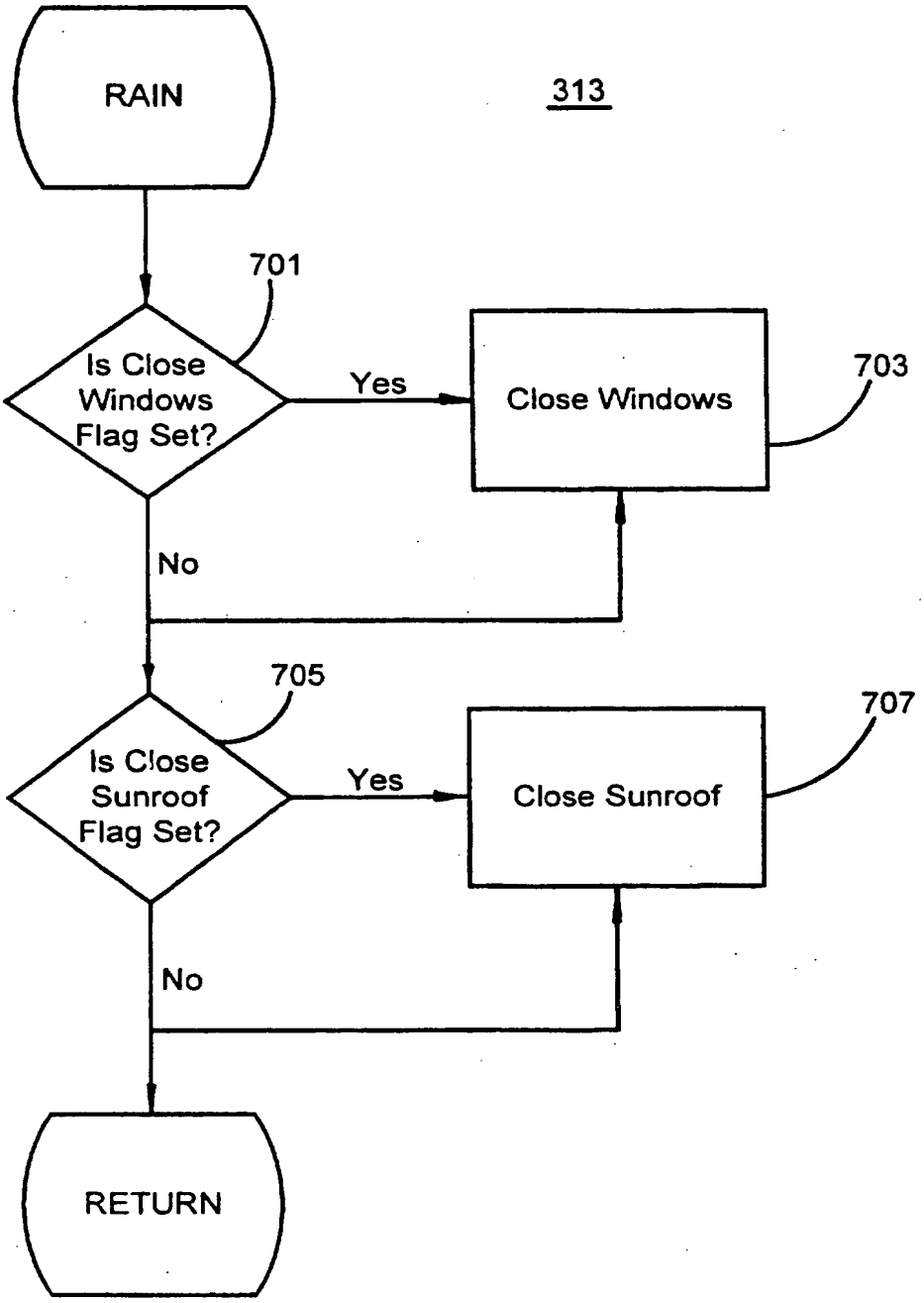

RAIN
313
701
Is Close Windows Flag Set?
Yes
Close Windows
703
No
705
Is Close Sunroof Flag Set?
Yes
Close Sunroof
707
No
RETURN

Fig. 10

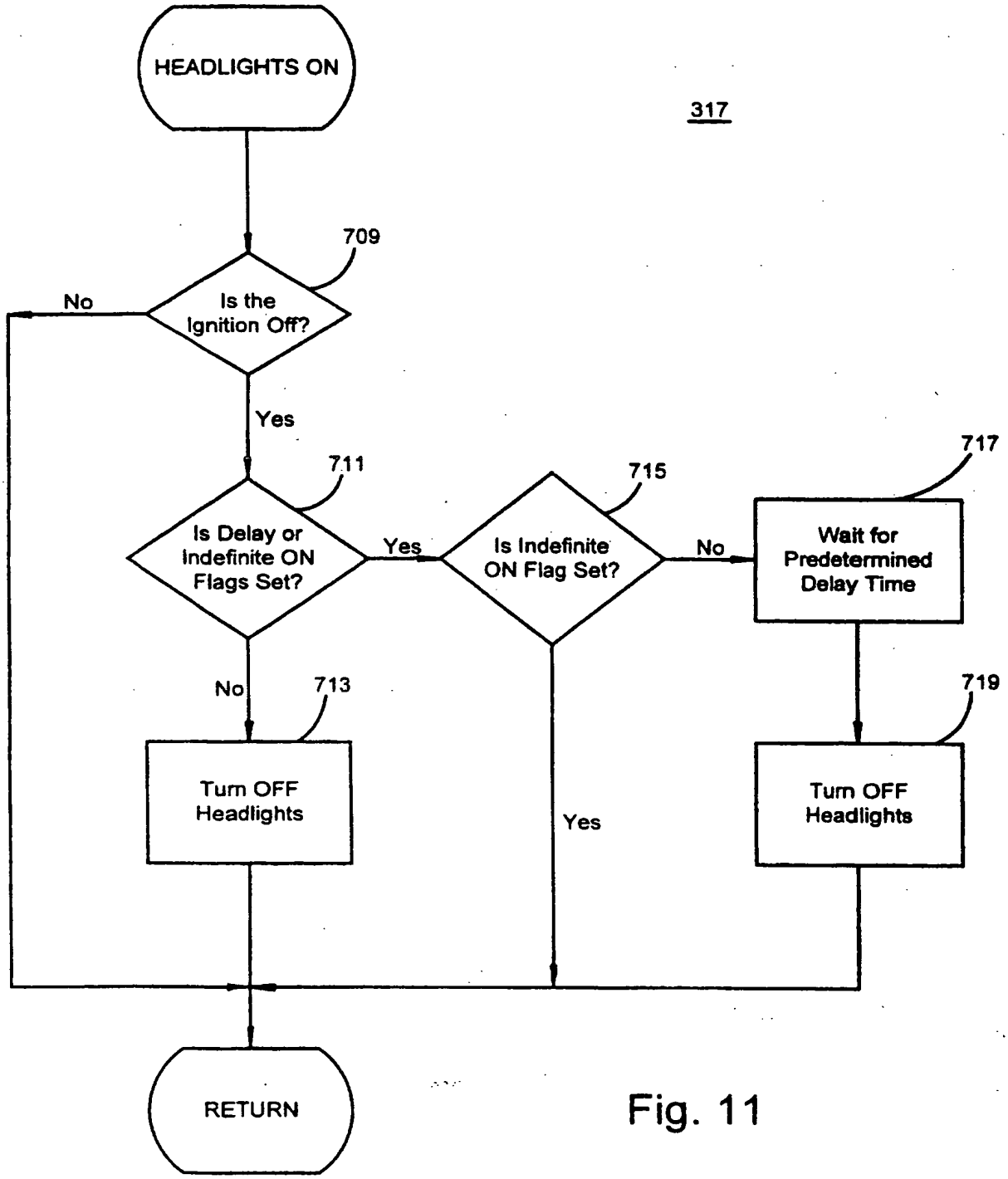

HEADLIGHTS ON
317
709
Is the Ignition Off?
No
Yes
711
Is Delay or Indefinite ON Flags Set?
Yes
715
Is Indefinite ON Flag Set?
No
717
Wait for Predetermined Delay Time
No
713
Turn OFF Headlights
Yes
719
Turn OFF Headlights
RETURN

Fig. 11

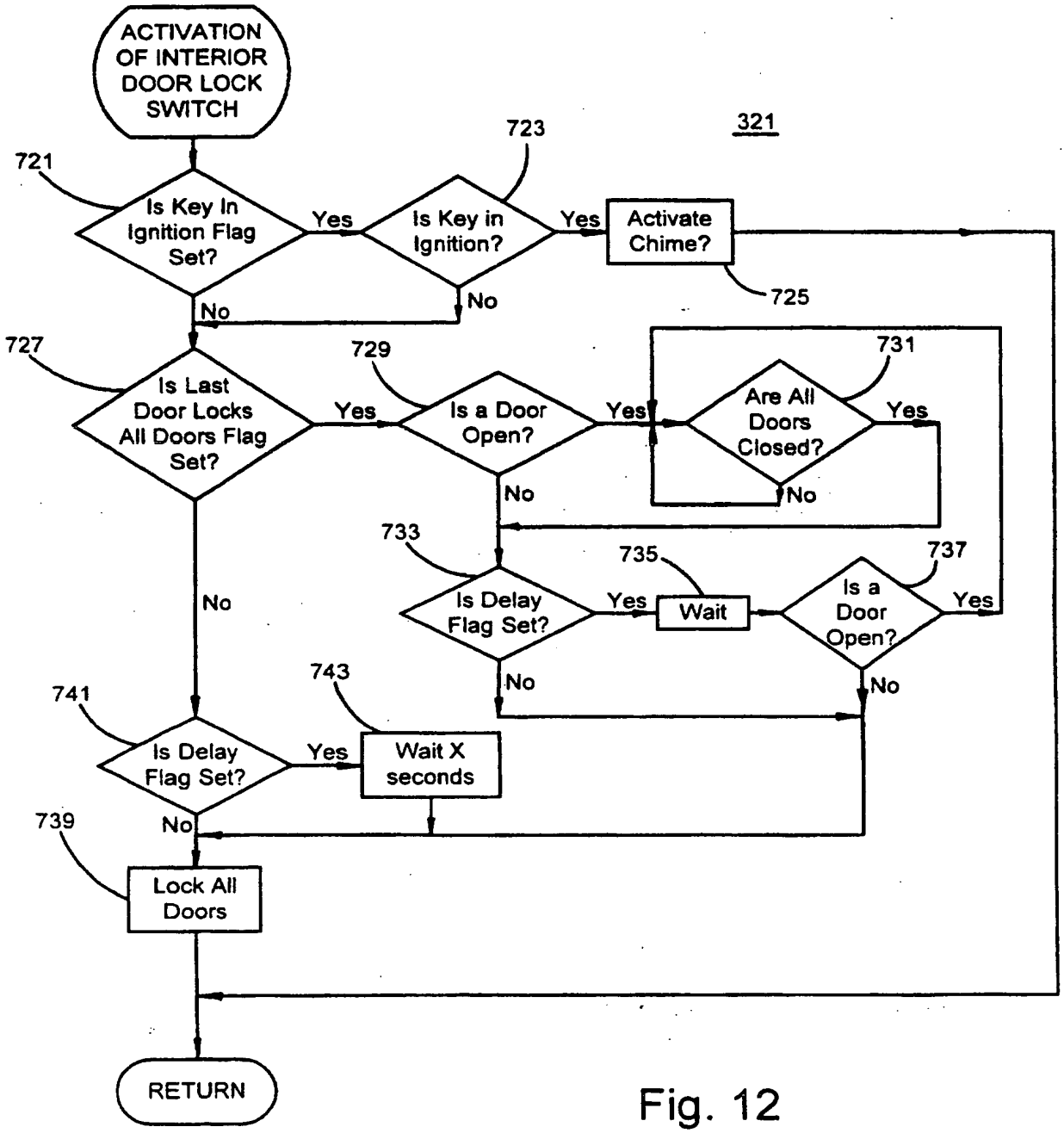

ACTIVATION OF INTERIOR DOOR LOCK SWITCH
321
721
Is Key In Ignition Flag Set?
Yes
723
Is Key in Ignition?
Yes
Activate Chime?
725
No
No
727
Is Last Door Locks All Doors Flag Set?
Yes
729
Is a Door Open?
Yes
731
Are All Doors Closed?
Yes
No
No
733
Is Delay Flag Set?
Yes
735
Wait
737
Is a Door Open?
Yes
No
No
No
741
Is Delay Flag Set?
Yes
743
Wait X seconds
739
No
Lock All Doors
RETURN

Fig. 12

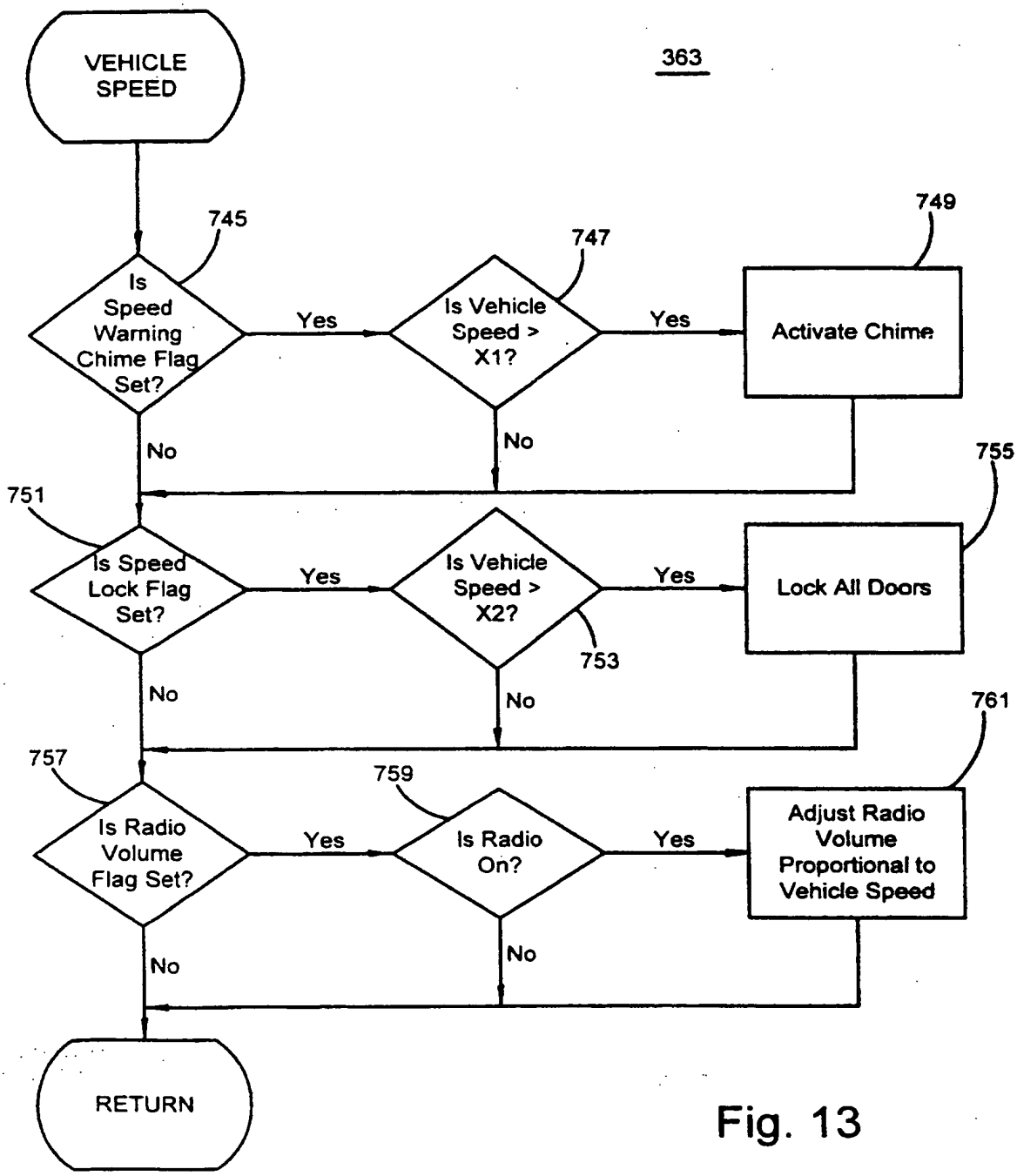

VEHICLE SPEED
363
745
Is Speed Warning Chime Flag Set?
Yes
747
Is Vehicle Speed > X1?
Yes
749
Activate Chime
No
No
751
Is Speed Lock Flag Set?
Yes
Is Vehicle Speed > X2?
Yes
753
755
Lock All Doors
No
No
757
Is Radio Volume Flag Set?
Yes
759
Is Radio On?
Yes
761
Adjust Radio Volume Proportional to Vehicle Speed
No
No
RETURN

Fig. 13

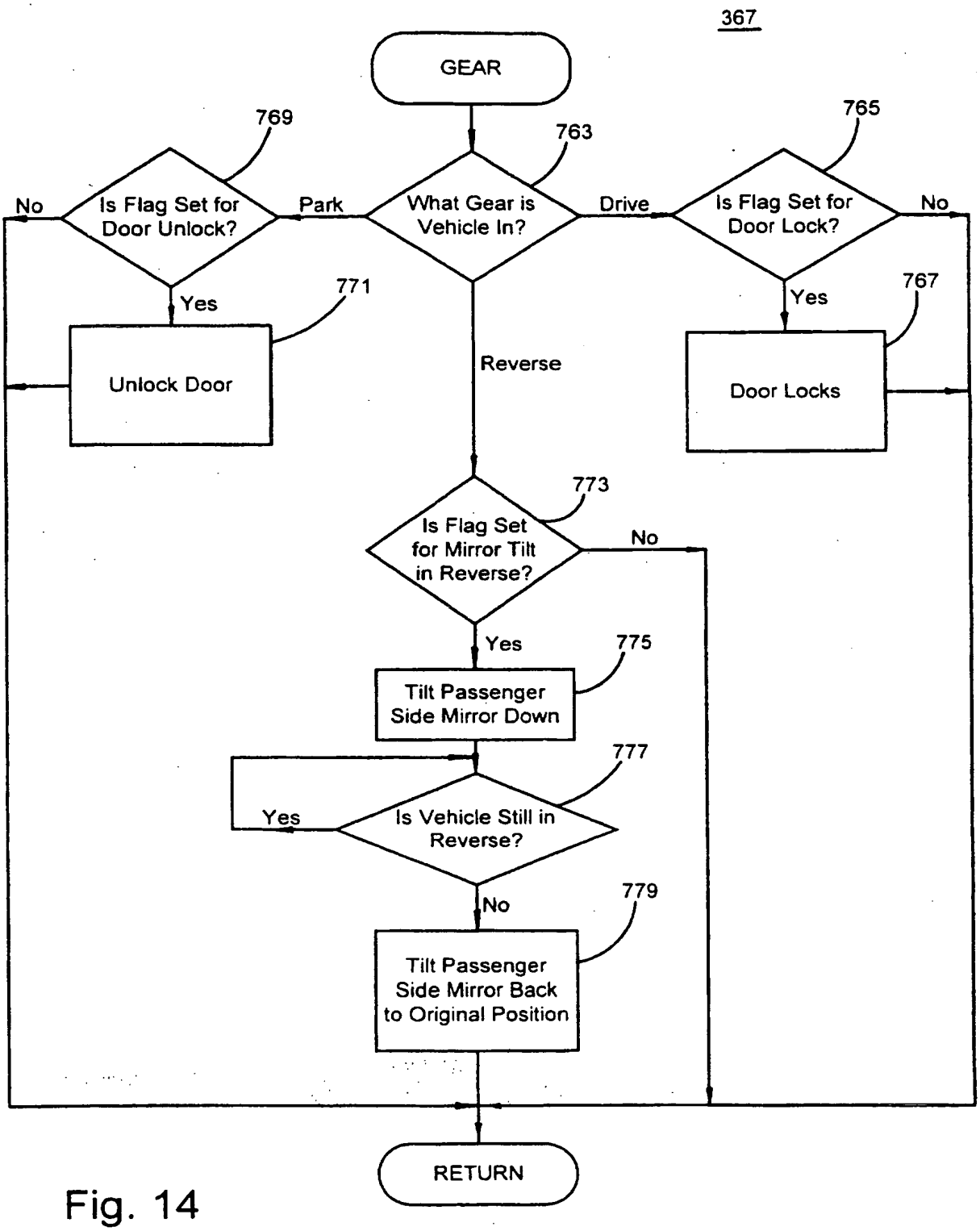

367
GEAR
763
What Gear is Vehicle In?
Park
Reverse
Drive
769
Is Flag Set for Door Unlock?
No
Yes
771
Unlock Door
765
Is Flag Set for Door Lock?
No
Yes
767
Door Locks
773
Is Flag Set for Mirror Tilt in Reverse?
No
Yes
775
Tilt Passenger Side Mirror Down
777
Is Vehicle Still in Reverse?
Yes
No
779
Tilt Passenger Side Mirror Back to Original Position
RETURN

Fig. 14

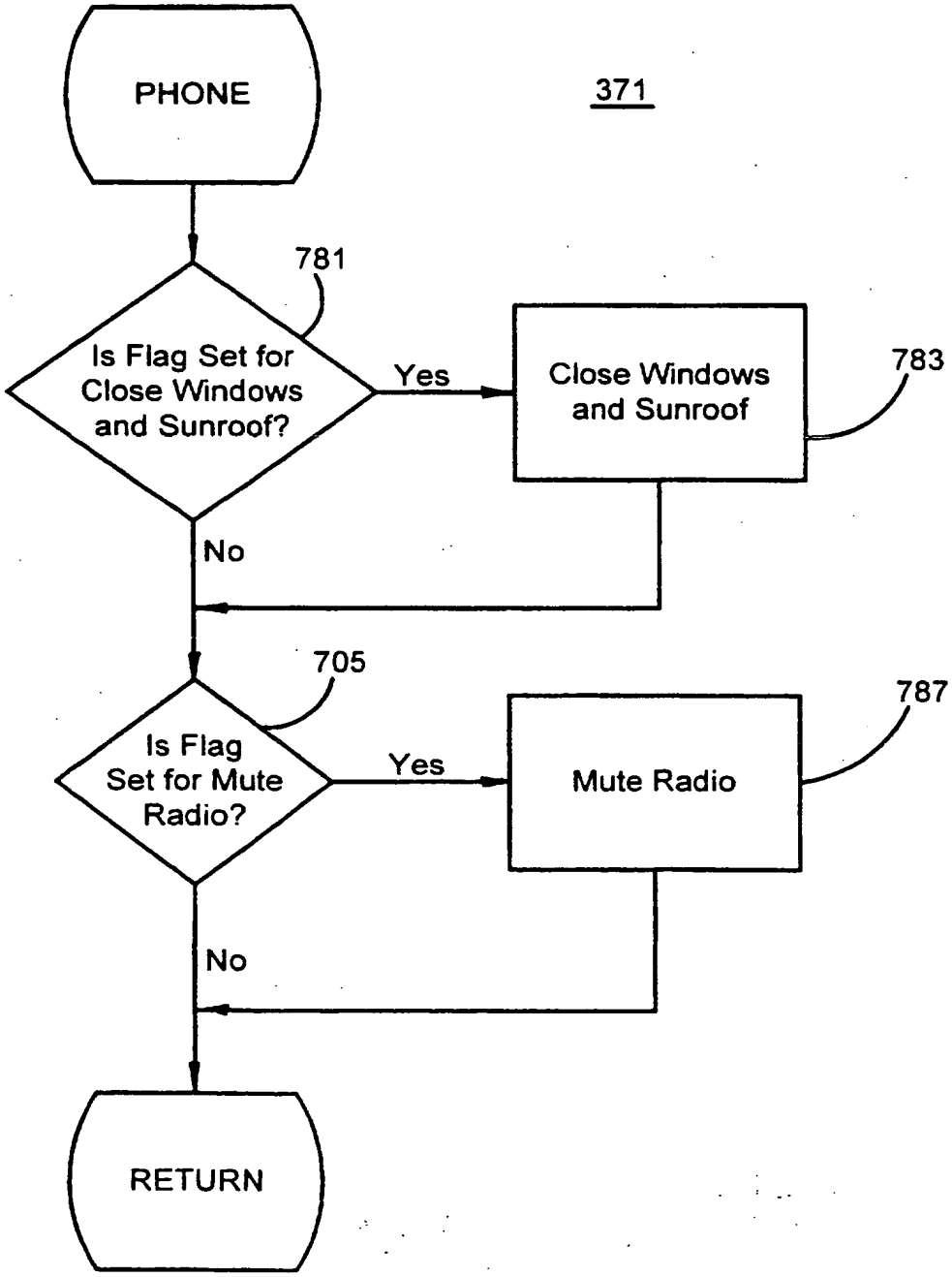

PHONE
371
781
Is Flag Set for Close Windows and Sunroof?
Yes
Close Windows and Sunroof
783
No
705
Is Flag Set for Mute Radio?
Yes
Mute Radio
787
No
RETURN

Fig. 15

REMOTE VEHICLE PROGRAMMING SYSTEM

BACKGROUND OF THE INVENTION

The present invention pertains to a remote vehicle programming system and, more particularly, a system for remotely reprogramming the manner in which a vehicle accessory is controlled.

As vehicle electronic systems and options become more sophisticated, vehicle owners have many new options for vehicle accessories from which to choose. The rapidly increasing number of new options has led to a nearly infinite number of combinations of options for vehicle accessories that are available. This extremely large number of combinations of vehicle accessories options existing on any one vehicle makes it much more difficult for a buyer to find a vehicle on a dealer's lot having the exact combination of vehicle accessory options that the buyer desires. Further, this wide array of vehicle accessory options that may exist in a particular vehicle increases the likelihood that no two drivers who share the vehicle will be able to agree on which options the vehicle should have. These concerns have given rise to the need for a programmable vehicle personalization system that allows an operator to select accessory operation for that vehicle according to their preferences at any time following the manufacture of the vehicle. U.S. Patent No. 5,040,990 issued on August 20, 1991 discloses one such system in which selected vehicle options can be programmed by the vehicle operator. U.S. Patent No. 5,113,182 entitled VEHICLE SYSTEMS CONTROL issued May 12, 1992 also discloses a programmable vehicle personalization system. Although programmable vehicle personalization systems exist, there remains a need for a system that does not require extensive effort by the vehicle operator to reprogram the manner in which the vehicle's accessories are controlled.

SUMMARY OF THE INVENTION

The present invention provides vehicle personalization to be remotely effected by a service provider using a paging system. According to one aspect of the present invention, a vehicle owner wishing to reprogram a vehicle, calls the service provider who effects reprogramming of an option control by transmitting control signals to the vehicle from a land-based pager transmitter to receiver mounted in the vehicle. Thus, because the service provider effects vehicle personalization, the vehicle owner need not have any technical knowledge as to how to operate the vehicle programming system. Another aspect of the present invention is to provide vehicle personalization for each person who

may operate the vehicle.

To achieve these aspects and other advantages, the vehicle accessory control system of the present invention includes a plurality of electrically operated vehicle accessories, a receiver to be mounted in a vehicle for receiving paging signals from a land-based paging transmitter, and a control circuit coupled to the receiver and to the vehicle accessories for controlling the operation of the vehicle accessories in accordance with a control program. The paging signals include an address uniquely identifying the vehicle and a reprogramming signal for reprogramming the operation of at least one of the vehicle accessories. The control circuit includes an input interface for receiving information regarding a plurality of sensed conditions, control means for controlling the operation of the vehicle accessories in accordance with the control program and in response to sensed conditions received from the input interface. The control circuit further includes reprogramming means for selectively reprogramming the control program in response to the detection of a paging signal including an address identifying the vehicle and the reprogramming signal, to selectively change the manner in which the control means controls the operation of at least one of the vehicle accessories.

These and other features, objects, and benefits of the invention will be recognized by those who practice the invention and by those skilled in the art, from reading the following specification and claims together with reference to the accompanying drawing figures.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic diagram of a system embodying the present invention;

Fig. 2 is an electrical circuit diagram in block form of the land-based facility illustrated in Fig. 1;

Fig. 3 is an electrical circuit diagram in block form of the vehicle electrical circuit embodying the present invention which is used in association with the system shown in Figs. 1 and 2;

Figs. 4a and 4b are electrical circuit diagrams in block form of an optional interface circuit associated with the electrical circuit shown in Fig. 3;

Figs. 5a-5k are flow diagrams of the main control program employed with the microprocessor shown in Fig. 3;

Figs. 6a and 6b are flow diagrams of a first subroutine that may be called by the main control program;

Fig. 7 is a flow diagram of a second subroutine that may be called by the main control program;

Figs. 8a and 8b are flow diagrams of a third subroutine that may be called by the main control program;

Fig. 9 is a flow diagram of a subroutine that may be called by the third subroutine;

Fig. 10 is a flow diagram of a fourth subroutine that may be called by the main control program;

Fig. 11 is a flow diagram of a fifth subroutine that may be called by the main control program;

Fig. 12 is a flow diagram of a sixth subroutine that may be called by the main control program;

Fig. 13 is a flow diagram of a seventh subroutine that may be called by the main control program;

Fig. 14 is a flow diagram of a eighth subroutine that may be called by the main control program; and

Fig. 15 is a flow diagram of a ninth subroutine that may be called by the main control program;

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring initially to Fig. 1, there is shown a land-based installation and vehicle embodying one preferred embodiment of the present invention. The land-based system is designed for controlling a variety of selectable vehicle options for a plurality of vehicles, each of which include the remotely programmable electrical control system of the present invention. The land-based facility 10 can be a car dealership, for example, or an independent facility which includes a service department 11 for providing the transmission of control signals to vehicles subscribed to the system, typically the service department of an automotive dealership from whom the vehicle 20 was purchased. The service department includes an operator 12 with access to a computer terminal 13 with a keyboard 14 (Fig. 2). The terminal can be a typical PC with an RS-232 data output port coupled to a modulator 16 in turn coupled to a transmitter 18 for transmitting address and control signals by an antenna 19 (Figs. 1 and 2) to the receiving antenna 22 of a vehicle 20. It is understood that nationwide there will be a sufficient number of land-based facilities to service vehicles in the system. As satellite communicates improve, it will be

possible for a single facility to send such information using DBS (Direct Broadcast Satellite) in which the vehicle antenna is a satellite receiving antenna. Alternatively, satellite communications can be used as one link through several land-based relay stations.

In the system shown in Fig. 1, the operator 11 will receive a request from a vehicle owner, typically by a normal telephone request, that a certain vehicle option is either to be enabled or disabled. Such an operation may, for example, be the activation or deactivation of a "LAST DOOR LOCKS ALL DOORS" feature. The operator 11 responds to the request which identifies the vehicle either by owner or VIN number (or both) by entering in keyboard 14 the vehicle code which is typically an address associated with the particular vehicle and a reprogramming command associated with the requested personalization of the vehicle option change for such vehicle. This paging signal is transmitted by the service department using the equipment shown in Fig. 2 and received and demodulated by the vehicle system as described in greater detail below in connection with Figs. 3 and 4, which responds to the reprogramming command to carry out the reprogramming control function.

A variety of modulation schemes can be used for the transmission of information between land-based facilities and vehicles, however, standard commercially available GSC or POCSAG paging systems are presently preferred. In the Fig. 1 schematic diagram shown, a reprogramming command can be two 23 bit words in the standard GSC paging format which uniquely identifies each vehicle in the system. Following the address for the vehicle, the actual reprogramming command data is sent, which in this paging format can be up to eight words or fifteen bits each. Other paging formats such as the POCSAG format can also be employed which also provides address code words and message code words. A description of these two formats are set forth in detail in Appendix A to this Specification.

In the example shown in Fig. 1, the vehicle operator has requested that the memory seat be disabled and the necessary paging signal including the reprogramming command is transmitted to the vehicle electrical control system 30 shown in Fig. 3 which includes the vehicle antenna 22 and a receiver and demodulator shown by block 24 for receiving the vehicle address and reprogramming command and applying it to a microcontroller 35. Once received and decoded, the reprogramming command is executed as described below and an indication that the command has been received and executed is provided on the alpha-numeric display 40 in the vehicle.

In the installation shown in Figs. 1 and 2, the modulator 16 responds to the vehicle identification code and the reprogramming command signal entered on keyboard 14 and transmitted by conventional commercially available modulator 16 and transmitter 18 to provide the desired address and reprogramming in either the GSC or POCSAG paging formats. Transmitter 18 typically operates on a frequency within the 137-175 MHz (VHF band) or within the 405-513 MHz (UHF band), while the modulator provides FM FSK tone modulation for the RF carrier signal to provide a composite output signal at transmitting antenna 19 which provides the address and reprogramming information to vehicles which are part of the system. Typically, the receiver will be an intrical part of the vehicle when purchased, and the dealer can either include the options select control system as part of the vehicle cost or can provide it as a monthly subscription service to the vehicle owner. Access to the unique vehicle identification code address for controlling options, however, will typically only be available to the vehicle dealer or associated service centers.

The vehicle electrical control system 30, is shown in Figs. 3 and 4, and include as shown in Fig. 3, a microcontroller 35 such as a Motorola MC68HC05, which receives demodulated signals from the receiver 24 shown enclosed within dotted lines in Fig. 3 via a data bus 27. The receiver 24 is a typical duo-conversion receiver having first and second local oscillators 21 and 23, appropriate bandpass filters and amplifiers, and a demodulator circuit 25 which provides digital data output on a data bus 27 to an input of microcontroller 35. Microcontroller 35 includes an integral non-volatile memory for retaining data when the vehicle is not in operation. In vehicles including a single wire multiplex bus 42, an output terminal 43 of microcontroller 35 is coupled to the input of a multiplex communication circuit 44 comprising a 28 pin integrated circuit which is coupled by output conductor 47 to a single wire data bus 42. The average data rate for the multiplex circuit 44 is 10.4 kilobits per second. Microcontroller 35 communicates with circuit 44 through its SPI serial interface port 43. When circuit 44 receives a message over the bus 42, it interrupts the microprocessor, which in turn initiates communication with the circuit through its SPI port. Microprocessor 35 then reads the data from the SPI register and acts upon the information. The multiplexing scheme is set forth in SAE standard J1850 and is universally used in the automotive industry.

The vehicle control system 30 includes a power supply 32 which supplies regulated 5 and 12 volt DC to the various individual circuit blocks shown in Figs. 3 and 4

reverse gear switch input; a drive gear switch input; a park gear switch input; a rain sensor; an interior thermometer; an exterior thermometer; an engine temperature sensor; an oil pressure sensor; a rear defrost switch; door open/closed sensors; a driver's exterior door lock sensing circuit; and a headlight switch. As will be apparent from the following description of the operation of the foregoing system, microcontroller 35 and microcontroller 70 utilize various combinations of these input signals to control the various vehicle accessories associated with the control modules connected to multiplex bus 42 in a manner defined by a control program stored in a non-volatile memory of the respective microcontroller.

Figs. 5-15 show an example of a main control program and its various subroutines that may be used to control the operation of various combinations of vehicle accessories. Upon reading this Specification, those skilled in the art will recognize that such a control program may be implemented in many different forms taking into account the large number of possible combinations of vehicle accessories that the main control program is responsible for controlling. Further, those skilled in the art will recognize that various functions of the exemplary main control program may be delegated to microcontroller 70 and/or the various control modules associated with the vehicle accessories. In general, the main control program utilizes a modifiable data structure to determine which of several possible subroutines to execute in response to a given input signal. As exemplified in the main control program as described below, such a data structure may take the form of a plurality of tables, each associated with one of several vehicle operators, including a plurality of entries corresponding to flags read from these tables by the main control program to determine the desired accessory control operations to be executed in association with the current vehicle operator.

Referring to Fig. 5a during system initialization, microcontroller 35 begins the execution of the main control program by clearing its RAM, recalling the last user ID by reading the same from the non-volatile memory, and reading a flag table associated with the last ID (step 201). Initially, the associated flag table may be set in the factory or by the dealer to specify default values. As described below, the flags in the flag table may subsequently be modified by a reprogramming signal included in a paging signal having the vehicle's ID.

Following initialization, microcontroller 35 periodically wakes from a sleeping state to turn on its RF receiver to determine whether a signal is received from a remote

keyless entry (RKE) transmitter (step 203). If the RKE transmitters associated with the vehicle each transmit different user IDs, microcontroller 35 may be programmed to read the ID from the signal transmitted from the RKE transmitter and compare the received ID with that stored in memory in association with the last user ID (step 205). If a new ID has been received, microcontroller 35 selects the flag table associated with the new ID and sets a new ID flag for subsequent reference (step 207) prior to executing an RKE subroutine (step 209). On the other hand, if the received ID is the same as the last ID, or if the transmitted signal does not include a user ID, microcontroller 35 proceeds directly to the steps defining the RKE subroutine 209.

Referring to Figs. 6a and 6b, which show the steps performed in RKE subroutine 209, microcontroller 35 first will determine whether the person activating RKE transmitter double-clicked any of the RKE transmitter buttons (step 401). If microcontroller 35 detects a double-click, it then checks a predefined location within the flag table associated with the user ID to determine whether a flag has been set to instruct microcontroller 35 to perform a panic routine in which microcontroller 35 responds to a double-click by honking the horn and flashing the headlights (step 405) prior to returning to the main control program at step 211 (Fig. 5a). If microcontroller 35 does not detect a double-click, or if the double-click panic flag is not set, microcontroller 35 determines whether the signal received from the RKE transmitter corresponds to a door lock signal (step 407).

In the example shown in Fig. 6a, there are two options that may be set to change the manner by which the microcontroller 35 controls the vehicle accessories in response to an RKE lock signal. The first option prevents the user from locking the vehicle when a key is detected in the ignition. To implement this option, the RKE subroutine 209 first checks whether the associated flag has been set in the flag table (step 409) and then checks whether an input signal is received from an ignition key sensor (step 411). If a key is in the ignition, microcontroller 35 will not lock the doors and will proceed to step 211 in the main control program. If a key is not in the ignition, or if the flag is not set for this option, microcontroller 35 proceeds to lock all the doors of the vehicle (step 413).

The second option associated with an RKE lock signal is to honk the horn after the doors have been locked as a confirmation to the vehicle operator. Thus, after locking all the doors in step 413, microcontroller 35 next determines whether the flag associated with this second option has been set (step 415). If the flag has not been set, microcontroller

proceeds to execute step 211 in the main control program and the routine for honking the horn after locking all the doors would remain a dormant subroutine which could not be executed unless the flag associated with this option has been set in the flag table associated with the user.

If in step 407, microcontroller 35 determines that the transmitted RKE signal is not a lock signal, it will then determine whether the receive signal is an unlock signal (step 419). If the receive signal is an unlock signal, microcontroller 35 determines whether a flag has been set to instruct microcontroller 35 to unlock the driver's door (step 421). If the flag has been set, microcontroller 35 only unlocks the driver's door in response to the RKE unlock signal (step 423). However, if this flag has not been set, microcontroller 35 unlocks all the doors in response to a received RKE unlock signal (step 425).

RKE subroutine 209 provides for several selectable control routines that microcontroller 35 may execute in response to receiving an RKE signal from a third button on the RKE transmitter. Thus, if in steps 407 and 419, microcontroller 35 determines that the received RKE signal is not a lock or unlock signal, it assumes the receive signal is associated with a third RKE button and determines in steps 427, 431, 435, 439, 443, and 451 which control operation is to be performed in response to the received RKE signal by checking the associated flags at predetermined locations in the flag table. In response to a signal corresponding to the third RKE button, microcontroller 35 may unlock the fuel door (step 429), unlock the trunk (step 433), turn on and off the headlights (step 437), honk the horn (step 441), lock the doors (step 449), or unlock either the driver's door (step 455) or all the doors (step 457). If the flag is set for the third RKE button to lock the doors, microcontroller 35 may determine whether the flag is set (step 445) to honk the horn (step 447) to confirm that all the doors have been locked (step 449). Further, if the flag is set for the third RKE button to unlock the doors, microcontroller 35 can determine whether to unlock only the driver's door or all the doors by checking whether a flag is set in the flag table (step 453).

Referring back to Fig. 5a, if microcontroller 35 determines in step 203 that a signal has not been received from a RKE transmitter, or following completion of the RKE subroutine 209, microcontroller 35 checks whether an input is received from a circuit detecting whether the driver's door is being unlocked from the exterior with a key (step 211). If a user ID may be input from a keypad on the exterior surface of the door or

from a key itself, microcontroller 35 determines whether a detected ID is different from the last ID stored in memory (step 213). If the ID is not different, microcontroller 35 selects the flag table associated with the last ID stored in memory and proceeds to execute subroutine 217. Otherwise, microcontroller 35 selects a flag table associated with the new ID (step 215) prior to executing subroutine 217.

Subroutine 217 is shown in Fig. 7 and begins with step 501 in which microcontroller 35 checks whether an unlock all doors flag has been set. If this flag has been set, microcontroller 35 unlocks all the vehicle's doors (step 503) in response to a door unlock signal received through the keyslot or keypad on the exterior of the driver's door. Alternatively, if the unlock all doors flag is not set, microcontroller 35 unlocks only the driver's door (step 505).

In association with the keyslot on the driver's door, three different options may be selected upon a detection of a second rotation of the key in the keyslot (step 507). If an unlock trunk flag is set (step 509), microcontroller 35 unlocks the trunk (step 511). If the unlock trunk flag is not set, but an unlock fuel door flag is set (step 513), microcontroller 35 may unlock the fuel door (step 515). If neither the unlock trunk or the unlock fuel door flags are set, microcontroller 35 may do nothing in response to a detection of a second rotation of the key in the keyslot. If a second rotation is not detected, or after the preprogrammed function has been executed, microcontroller 35 proceeds to execute step 219 in Fig. 5b.

In step 219 of Fig. 5b, microcontroller 35 checks whether a new driver ID signal has been received. Because various mechanisms may be used to input a driver's ID such as a keypad or a user ID dedicated pushbutton, it may be appropriate for microcontroller 35 to monitor such input mechanisms to determine whether a new driver ID signal has been received. If a driver ID signal is received that is the same as the last user ID stored in memory, or if no new driver ID signal is received, microcontroller 35 leaves all the settings in the vehicle to those last used by the driver with the last ID stored in memory (step 221) and the program advances to step 281 shown in Fig. 5f. If a new driver ID signal is received, microcontroller 35 executes a routine (steps 223-279, Figs. 5b-5e) to initialize various vehicle accessories to those preferred and set by the driver with the received new driver ID utilizing the flag table associated with this new ID (step 223).

A first vehicle accessory that may be initialized is the position of the driver's seat. Thus, if the driver with the new ID has selected the last seat position memory feature,

microcontroller 35 will determine in step 225 that the associated flag has been set and will set the seat position to that last used by the driver with the new ID by reading seat positioning parameters stored in non-volatile memory the last time this driver used the vehicle (step 227). Next, microcontroller 35 will check whether a flag is set for a last mirror position feature (step 229), which if selected, causes microcontroller 35 to set the mirror positions to that last used by the driver with the new ID (step 231). If this flag is not set, the routine for setting the mirror positions is dormant with respect to the driver with the newly detected ID.

If the vehicle includes mirrors with electronically adjustable reflectivity, microcontroller 35 may check whether a flag has been set for a last mirror reflectivity feature (step 233). If the flag has been set for this feature, microcontroller 35 sets the mirror reflectivity to that last used by the driver with the new ID in step 235.

In step 237 (Fig. 5c) microcontroller 35 determines whether the vehicle ignition is on. If the vehicle ignition is not on, microcontroller 35 advances to step 281 in Fig. 5f and skips the remaining portion of the new user initialization routine. If the ignition is on, microcontroller 35 proceeds in step 239 to determine whether a flag has been set for a last temperature setting feature. If the flag has been set for this feature, microcontroller 35 will set the interior temperature for the climate control system to that last used by the driver with the new ID by retrieving the last used temperature setting from the non-volatile memory (step 241).

If the vehicle includes a compass that allows for selection of a feature that computes variations in heading based on the geographic location of the vehicle, microcontroller 35 may determine in step 243 whether the flag associated with this feature has been set. If the flag has been set, the compass will be initialized for variation based on geographic location (step 245). Otherwise, the compass will be initialized for operation without variation for geographic location (step 247).

Next in step 249 (Fig. 5d), microcontroller 35 may check whether a flag has been set for a last radio volume feature (step 249). If the last radio volume feature has been selected by the user with the detected ID, microcontroller 35 sets the radio volume to that last used by the driver with the new ID (step 251).

If a flag has been set for a last radio station feature, microcontroller 35 will detect if the flag has been set (step 253) and set the radio station to that last used by the driver with the new ID (step 255). Similarly, if microcontroller 35 detects that a flag has been

set for a radio preset memory feature (step 257), microcontroller 35 sets the radio station presets to those last used by the driver with the new ID (step 259).

If the vehicle radio includes a display that displays either the radio station or the time of day, a vehicle operator may wish to select what is displayed on the radio display as a default condition. Thus, microcontroller 35 may look for a flag corresponding to a radio station display default in step 261 and display the radio station as a default on the radio display (step 263) if the flag is set. Otherwise, the time of day will be displayed on the radio display as a default.

As vehicle sophistication improves, more and more vehicles will include alpha-numeric displays to convey information to the vehicle operator. Because such vehicles may be used in countries having different primary languages, it is advantageous to allow for different languages to be displayed on the vehicle's alpha-numeric display. Moreover, it would be even more advantageous to provide for a vehicle alpha-numeric display that can be programmed to display different languages for different drivers that may use the vehicle. To this end, the main control program includes a step (265) that causes microcontroller 35 to check whether a flag for a non-default language (i.e., English) has been selected for the vehicle displays. If the flag has been set, microcontroller 35 sets the display language to that last used by the driver with the new ID (step 267) by setting a pointer to a set of memory addresses at which the selected language display messages are stored.

A related feature provided by the present invention permits the vehicle operator to select display parameters such as Fahrenheit or Centigrade, miles or kilometers, miles per hour or kilometers per hour, and/or gallons or liters, to be displayed in the vehicle's gauges and other display screens. Thus in step 269, microcontroller 35 first checks whether a flag has been set for a non-default display parameter and then sets the display parameters to those last used by the driver with the new ID (step 271) if the flag has been set.

The present invention further allows each vehicle operator to customize the vehicle's displays by reconfiguring message screens and, if desired, the message screen location. Thus, if a vehicle includes several message screen displays, a vehicle operator may reconfigure these displays such that a compass heading is displayed on a different message screen than that used in a default condition. Therefore, if microcontroller 35 determines in step 273 that a flag is set for a non-default display configuration, it will set

the display configuration to that last used by the driver with the new ID (step 275).

If the vehicle employs a reconfigurable instrument panel display, the present invention allows for the vehicle operator to reconfigure the display gauges on the instrument panel display by changing their location, size, color, or existence as displayed on the instrument panel. To allow various vehicle operators to select their desired preference, microcontroller 35 determines in step 277 whether a flag has been set for a non-default gauge configuration and sets the gauge configuration to that last used by the driver with the new ID in step 279 if the flag has been set.

After completing steps 277 and 279, microcontroller 35 has completed the steps associated with initializing the vehicle for a driver having a new ID that is different from that of the last ID stored in memory. It will be appreciated by those skilled in the art that the settings associated with the last driver will be maintained and utilized during initialization provided a new user ID is not received. Following this initialization process, microcontroller 35 monitors a timer to determine when to interrupt the main program to look for a paging signal (step 281). If it is time to interrupt the main program, microcontroller 35 executes interrupt service routine 283, which is described below with reference to Figs. 8a, 8b, and 9. Interrupt service routine begins with step 601 in Fig. 8a in which microcontroller 35 turns on an RF receiver for 250 msec. With the receiver on, microcontroller 35 looks for a preamble signal received from the demodulator in step 603. Each of the GSC and POCSAG paging formats provide a preamble digital signal and if one is not detected by the microcontroller, the interrupt counter is reset in step 605 and the program returns to step 285 (Fig. 5f) of the main program. In the event a preamble is detected, however, the receiver remains activated for receiving one of two different vehicle addresses uniquely associated with the vehicle (step 607). If an address is received, a bit error correction subroutine 609 is executed to assure that the address has been correctly received. The first vehicle address is one in which a vehicle option is to be changed by a subsequently transmitted reprogramming signal. The second address is one which is followed by a telephone number page or alpha-numeric message to be displayed. Each of these addresses are uniquely associated with a single vehicle.

The error correction routine is a standard subroutine for the different paging systems. The bit error correction subroutine is initiated in step 609 and is described in detail with reference to Fig. 9. The error correction subroutine 609 causes

microcontroller 35 to read an address or message data block (step 621) and to divide the received data by a binary format constant for the respective paging formats (step 623) and to store the remainder, which is known as the syndrome (step 625). Then, microcontroller 35 tests to determine whether the syndrome is 0 (step 627). If the syndrome is 0, the data is correct and the program returns to step 611 of the interrupt service routine. If, however, the syndrome is not 0, the data is corrected by the bit indicated by the syndrome (step 629) and the data is retested through the program loop including steps 623-627.

Once the bit error correction subroutine has been completed and a correct paging preamble detected, the interrupt service routine proceeds to test whether one of the vehicle's addresses has been detected (step 611). If no address is received for the particular vehicle into which the preprogrammed addresses of microcontroller 35 is installed, the program proceeds to step 605 and the interrupt counter is reset and the program advances to the main program at step 285 (Fig. 5f). If, however, one of the vehicle's addresses has been detected, the program tests whether the address is a page information address or an option personalization address (step 613). If the address corresponds to the page address, microcontroller 35 receives the paging message, stores the message, and subsequently displays the message on a message screen (step 615). A detailed procedure for performing step 615 is disclosed in parent application Serial No. 08/390,241, the disclosure of which is incorporated by reference herein.

If the detected address corresponds to a personalization address, microcontroller 35 receives and decodes the paging signal and corrects errors therein using the bit error correction subroutine and subsequently defines the function in the reprogramming signal that is to be changed (step 617). Microcontroller 35 may determine from the received reprogramming signal which function is to be changed by accessing a look-up table and identifying which flags correspond to the commands included in the reprogramming signal. After identifying the flags corresponding to these commands, microcontroller 35 modifies the data structure it utilizes in determining the manner in which to control vehicle accessories by setting or resetting the flags in the flag table corresponding to a user ID also transmitted in the personalization paging signal. In this manner, microcontroller 35 reprograms the main control program as used to control vehicle accessories for a particular vehicle operator. As apparent from the foregoing and following description of the control program, the main control program includes both

active and dormant subroutines which may be activated or deactivated by the setting or resetting of its associated flag. Upon reading this disclosure, those skilled in the art will recognize that various other data structures or mechanisms may be employed to reprogram the manner in which a vehicle accessory control system controls the operation of the vehicle accessories in response to detected conditions, parameters, or vehicle operator initiated activation signals. For example, the various selectable routines defining manners in which a vehicle accessory can be operated may be separately stored and executed by the control module associated with that vehicle accessory whereby the main control program either alters the data structure used by the routines in the control module or relays the reprogramming signal to the appropriate control module, which alters the data structure used by its associated control routine. In such a case, the various control modules may directly receive and act upon a sensed condition, parameter, or vehicle operator initiated activation signals. Thus, the various routines and subroutines of the main control program may be separated and delegated to the various accessory control modules and be independently executed. Alternatively, the main control program could modify the data structure it uses itself to determine a particular command to issue to a vehicle accessory control module to activate the desired one of the subroutines stored in the control module.

If it is not time for the interrupt service subroutine to be executed or if the interrupt service routine has been executed, microcontroller 35 proceeds to execute step 285 in Fig. 5f. In step 285, microcontroller 35 checks whether a flag has been set to turn off the headlights if the battery voltage is low. If the flag is set, microcontroller 35 reads the detected battery voltage VB and compares the detected battery voltage VB to a threshold voltage V to determine whether the battery voltage is below a low voltage threshold (step 289). If the battery voltage is below this threshold, microcontroller 35 will turn off the headlights if they were on (step 291) to prevent further drain on the vehicle's battery.

Another feature that may be selected is to open the windows or a sunroof if the temperature in the interior of the vehicle exceeds a threshold temperature T1 to keep the interior of the vehicle relatively cool. Although this feature may be desirable for some individuals, it may be undesirable to other individuals who, for example, may frequently park their vehicles in a high crime area. Thus, the present invention provides the flexibility for each vehicle operator to select how microcontroller 35 will respond when

(in block 293) the interior temperature of the vehicle exceeds a threshold temperature T1. To prevent the windows or sunroof from being opened when it is raining, microcontroller 35 may first determine whether rain is sensed by a rain sensor in step 295. If it is raining, microcontroller 35 will not open the windows or sunroof. However, if it is not raining, microcontroller 35 will then check whether a flag has been set to open the windows when the interior temperature exceeds the threshold (step 297). If the flag has been set, microcontroller 35 will open the windows by a predetermined amount (step 299). If the flag for opening the windows has not been set, microcontroller 35 will check whether the flag has been set to open the sunroof (step 301). If the flag has been set, microcontroller 35 will issue the appropriate signal via multiplex bus 42 to an actuator for opening the sunroof (step 303). If the flag has not been set, microcontroller 35 will proceed to step 305 (Fig. 5g) without opening the windows or the sunroof.

If the interior temperature of the vehicle is below a lower, second temperature threshold T2, as may be the case during winter time (step 305), microcontroller 35 checks whether a flag has been set to heat the vehicle seats when the interior temperature falls below the second threshold T2 (step 307). If the flag has been set, microcontroller 35 will cause the vehicle's seats to heat (step 309). If the flag is not set, the routine associated with heating the seats is effectively disabled and the program advances to step 311 where microcontroller 35 determines whether the rain sensor has detected rain. If rain is detected, microcontroller 35 executes a rain subroutine 313 which will now be described in detail with reference to Fig. 10.

If rain is detected, microcontroller 35 checks whether a flag is set to close the windows (step 701). If the flag is set, microcontroller 35 will issue the appropriate control signals to the window actuators to close the windows (step 703). Then, microcontroller 35 will check whether a flag has been set to close the vehicle's sunroof (step 705). If the flag has been set, microcontroller 35 will issue the appropriate command to close the sunroof (step 707). Following execution of the rain subroutine 313, microcontroller 35 executes step 315 (Fig. 5g) to determine whether the vehicle's headlights are presently on. If the headlights are on, microcontroller 35 executes a headlights ON subroutine 317, which is described in detail below with reference to Fig. 11.

In the headlights ON subroutine 317, microcontroller 35 first tests whether the vehicle ignition is off (step 709). If the ignition is off, microcontroller 35 exits the

headlights ON subroutine and returns to step 319 (Fig. 5g) of the main control program. If, on the other hand, the vehicle ignition is off and the headlights are on, microcontroller 35 determines in step 711 whether a delay flag or an indefinite ON flag has been set. If neither flag has been set, microcontroller 35 turns off the headlights (step 713) and returns to the main control program. If one of these flags are set, microcontroller 35 then determines whether the flag that is set is the indefinite ON flag (step 715). If the indefinite ON flag is set, microcontroller 35 returns to the main control program without turning off the headlights. If the indefinite ON flag is not set, microcontroller 35 assumes that the delay flag has been set and waits for the predetermined delay time (step 717) before turning off the headlights (step 719) and returning to the main control program.

The next step in the main control program instructs microcontroller 35 to determine whether an interior door lock switch has been depressed (step 319). If an interior door lock switch has been depressed, microcontroller 35 executes an associated subroutine 321, which is described below with reference to Fig. 12.

The subroutine 321 associated with the activation of an interior door lock switch begins with step 721 which causes microcontroller 35 to determine whether a flag has been set for a feature preventing the doors from being locked when a key is in the ignition. If this flag is set, microcontroller 35 determines whether there is a key in the ignition (step 723). If a key is in the ignition, microcontroller 35 activates a chime (step 725) and returns to the main control program without locking the doors in response to the activation of the interior door lock switch. If the key is not in the ignition or if the flag associated with this feature has not been set, microcontroller 35 next determines whether a flag has been set for a last door locks all doors feature (step 727). If this flag has been set, microcontroller 35 determines whether a door is presently open (step 729). If a door is presently open, microcontroller 35 will wait until all the doors are closed (step 731) before advancing to step 733 in which microcontroller 35 determines whether a flag is set to delay the activation of the locks for a predetermined time after all of the doors are closed. If this flag has been set, microcontroller 35 will wait for this predetermined time period (step 735) and again check whether a door has subsequently been opened (step 737). If a door has been reopened, microcontroller 35 returns to step 731 where it waits until all doors are closed. Once all the doors are closed and remain closed for the predetermined time period, microcontroller 35 locks all the doors (step 739) and returns

to the main control program. If, in step 733, the delay flag is not set, microcontroller 35 immediately proceeds to step 739 and locks all the doors without rechecking whether a door is subsequently opened.

If, in step 727, microcontroller 35 determines that the flag for the last door locks all doors feature has not been set, microcontroller 35 then checks whether a flag has been set to delay the locking of the doors following the activation of an interior door lock switch (step 741). If the delay flag has not been set, microcontroller 35 immediately locks all doors (step 739). On the other hand, if the flag has been set, microcontroller 35 waits a predetermined time period (step 743) before locking all doors (step 739) and returning to the main control program.

The main control program resumes at step 323 (Fig. 5h) where it is determine whether the vehicle ignition is on. If the vehicle ignition is on, the main control program advances to step 337 in Fig. 5i and if the ignition is off, microcontroller 35 determines whether the ignition was just turned off (step 325). If the ignition was not just turned off, the main control program returns to its beginning at step 203 in Fig. 5a as denoted by connection port A.

If the vehicle ignition was just turned off, microcontroller 35 checks whether a flag has been set for controlling the interior lights in response to the vehicle ignition being turned off (step 327). If the flag has not been set, the main control program returns to step 203 (Fig. 5a) of the main control program. If, however, the flag has been set, microcontroller 35 turns on the vehicle's interior lights (step 329) and starts a timer. The interior lights remain on until one of the following events takes place -- the expiration of a predetermined time period of, for example, thirty seconds (step 331) or the detection that a door has been opened and subsequently closed (step 333). Once one of these events has occurred, microcontroller 35 turns off the interior lights (step 335) and the program returns to step 203 at the beginning of the main control program.

As described above, if the vehicle ignition is detected as being on in step 323, the main control program advances to step 337 in Fig. 5i where microcontroller 35 determines whether a flag has been set for a low fuel level warning chime. If this flag has been set, microcontroller 35 checks the fuel level on the associated input line and determines in step 339 whether the detected fuel level is below a low fuel level threshold F. If the fuel level is low, microcontroller 35 will activate a warning chime (step 341) which may chime once or at a predetermined interval of, for example, once every five

minutes.

Next, microcontroller 35 checks whether a flag has been set for an engine temperature warning chime (step 343). If this flag has been set, microcontroller 35 obtains the detected engine temperature from the associated input terminal and determines whether the engine temperature exceeds a threshold temperature T3 (step 345). If the detected engine temperature T3, microcontroller 35 will activate a warning chime (step 347) once or at periodic intervals.

Another warning chime that may be set corresponds to a low oil pressure. Because this feature is optional, as are the other features relating to warning chimes, microcontroller 35 first determines whether the flag has been set for the oil pressure warning chime (step 349). If the flag has been set, microcontroller 35 reads the detected oil pressure from the associated input terminal and determines whether the detected oil pressure is less than a predetermined threshold P (step 351). If detected oil pressure is less than this threshold pressure, microcontroller 35 activates a warning chime (step 353).

Yet another feature that may be selected is to have your headlights automatically turn on at dusk or whenever an exterior ambient light level falls below a threshold level. To perform this feature, microcontroller 35 first checks whether a flag has been set for this feature (step 355) and retrieves the detected ambient light level from an associated input terminal and determines whether the detected ambient light level is below a threshold level L (step 357). If the detected level is below threshold L, microcontroller 35 will turn on the vehicle's headlights (step 359).

The present invention allows various accessories to be controlled in response to a detection of the vehicle speed. Thus, as the next step, microcontroller 35 may check whether any of the flags have been set that are related to the vehicle speed (step 361). If any of these flags have been set, microcontroller 35 will execute a vehicle speed subroutine 363, which is described below with reference to Fig. 13.

The vehicle speed subroutine 363 begins at step 745 at which microcontroller 35 determines whether a flag has been set for a speed warning chime. If this flag has been set, microcontroller 35 reads the vehicle speed from the associated input terminal and determines whether the speed exceeds a first speed threshold X1 (step 747). If the vehicle speed exceeds this threshold, which may be set manually to correspond to the speed limit, for example, microcontroller 35 activates a warning chime (step 749), which chimes periodically until the vehicle speed falls back below the first speed threshold X1.

Next, microcontroller 35 may check whether a flag has been set for a feature by which the door locks lock when the speed of the vehicle exceeds a threshold level (step 751). If the flag has been set, microcontroller 35 reads the vehicle speed from the associated input terminal and determines whether this speed exceeds a second speed threshold X2 (step 753). If the second speed threshold X2 is exceeded, microcontroller 35 proceeds to lock all the doors of the vehicle (step 755). Typically, the second speed threshold X2 will be set at a relatively low speed to insure the safety of the vehicle's occupants.

As the vehicle's speed increases, the interior noise level within the vehicle will also increase. Therefore, another feature that may be selected adjusts the radio volume proportional to the vehicle's speed. If, in step 757, microcontroller 35 determines that the radio volume flag has been set, it will then determine whether the radio is on in step 759. If the radio is on, microcontroller 35 will obtain the vehicle speed from the appropriate input line and adjust the radio volume proportionally to any changes in vehicle speed and will return to the main control program at step 365 in Fig. 5j.

In step 365, microcontroller 35 checks whether any flags have been set relating to gear position. If any such flags have been set, microcontroller 35 executes a gear position subroutine 367, which is shown in detail in Fig. 14. In the gear position subroutine 367, microcontroller 35 first determines what gear the vehicle is in (step 763). If the vehicle is in drive, microcontroller 35 next determines whether a flag has been set for a feature in which the doors are automatically locked when the vehicle is put in drive (step 765). If the flag has been set, microcontroller 35 locks all the doors (step 767) before returning to step 369 (Fig. 5j) of the main control program.

If the vehicle is in park, microcontroller 35 checks whether a flag has been set to automatically unlock the doors (step 769). If this flag has been set, microcontroller 35 automatically unlocks the doors when the vehicle is in park (step 771).

If the vehicle is in reverse, microcontroller 35 determines whether a flag has been set to automatically tilt the passenger side exterior mirror downward when the vehicle is in reverse (step 773). If this flag has been set, microcontroller 35 tilts the passenger side mirror downward to a predetermined angle (step 775) and determines whether the vehicle is still in reverse (step 777). When the vehicle is no longer in reverse, microcontroller 35 tilts the passenger side mirror back to its original position (step 779) before returning to the main control program. This mirror tilting feature is particularly suited for vehicle

operators who frequently parallel park their vehicles next to a curb.

At the next step in the main control program, microcontroller 35 checks whether there is an incoming phone call (step 369). If there is an incoming phone call, microcontroller 35 executes a phone subroutine 371 that identifies several selectable features relating to vehicle accessory operation in response to an incoming phone call. Phone subroutine 371 is shown in Fig. 15 and begins with microcontroller 35 determining whether a flag is set for a closed windows and sunroof feature (step 781). If this flag has been set, microcontroller 35 will close the windows and sunroof in response to an incoming phone call (step 783). By automatically closing the windows and sunroof when an incoming phone call is received, the vehicle operator will not have to fumble around to close all the windows and sunroofs to cut down on the interior noise so that the vehicle operator may subsequently answer the incoming phone call.

Another option that may be selected to make receiving a phone call much easier for a vehicle operator is a feature which automatically mutes the radio when an incoming phone call is received. If microcontroller 35 determines in step 785 that the flag is set for this feature, microcontroller 35 will automatically mute the radio (step 787) in response to the detection of an incoming phone call.

After determining that there is no incoming phone call or executing the phone subroutine 371, microcontroller 35 continues in the main control program by determining whether a window down switch has been depressed (step 373, Fig. 5j). If the vehicle operator has depressed the window down switch, microcontroller 35 will check a flag to determine the manner in which the window actuator is to be controlled in response to this vehicle operator initiated activation signal associated with a window down function (step 375). If the flag has been set for an express window feature, microcontroller 35 will automatically open the window all the way without regard to the length of time the button is depressed (step 377). If the flag has not been set, microcontroller 35 opens the window an amount proportional to the length of time the switch is depressed (step 379). Similarly, if a window up switch is depressed (step 381), microcontroller 35 determines whether a flag has been set for an express window up feature (step 383). If this flag has been set, microcontroller 35 closes the window all the way (step 385). Otherwise, microcontroller 35 will close the window an amount proportional to the length of time the switch is depressed (step 387).

The main control program then advances to step 389 in Fig. 5k, in which

microcontroller 35 determines whether the rear defrost switch has been depressed. If this switch has been depressed, microcontroller 35 will turn on the rear defrost and start a timer (step 391) and will check whether a flag has been set for a non-default ON time (step 393). If the flag has been set, microcontroller 35 will set and store an ON time value to the selected ON time (step 395). Otherwise, the stored and set ON time value will correspond to the default ON time for the rear defrost circuit. Then, microcontroller 35 will check whether the rear defrost ON time has expired (step 397) and will turn off rear defrost if the time has expired (step 399).

Next, microcontroller 35 checks whether a turn signal is on (step 401) and checks the flags for features associated with the turn signal. The first feature that may be selected increases the volume of a chime associated with the turn signal as the time the turn signal is on increases. Thus, if the associated flag is set for this feature (step 403), microcontroller 35 will increase the volume of the chime as the length of time that the turn signal is on increases in order to alert the driver if the turn signal did not turn off following a turn or lane change. If the flag is not set for this feature, microcontroller 35 will check whether a flag is set for a feature which activates a chime after a turn signal has flashed twenty times without a steering wheel correction being made (step 407). If this flag is set, microcontroller 35 will count the number of times the turn signal has flashed and will activate a chime after twenty flashes without a steering wheel correction being made (step 409).

Next, microcontroller 35 checks a flag associated with a feature for activating a chime upon the detection of a low exterior temperature (step 411). If the flag has been set, microcontroller 35 reads the external temperature from the associated input terminal and determines whether this temperature is less than a threshold T4, which may be, for example, 32° F or 0° C (step 413). If the external temperature is less than threshold T4, microcontroller 35 will activate a chime and display "ICE" on one of the vehicle's displays (step 415). The control application then returns to step 203 in Fig. 5a as denoted by connection port A.

Those skilled in the art will recognize that the main control program described above may be modified to include or eliminate or rearrange various steps associated with the control of the vehicle's accessories to accommodate various combinations of vehicle accessories and their control options. Further, the control program may be reprogrammed by invoking a program editing routine in response to a reprogramming

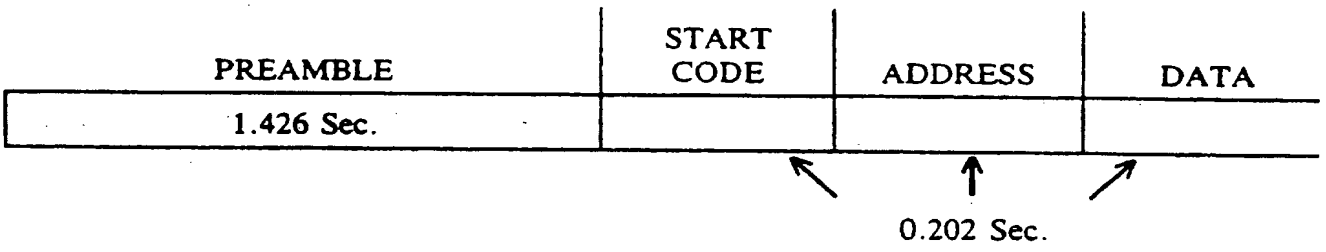
signal, which edits the main control program by adding or deleting command lines in the main control program that call the various subroutines relating to selectable control functions.

It will be understood by those who practice the invention and by those skilled in the art, that various modifications and improvements may be made to the invention without departing from the spirit of the disclosed concept. The scope of protection afforded is to be determined by the claims and by the breadth of interpretation allowed by law.

APPENDIX A

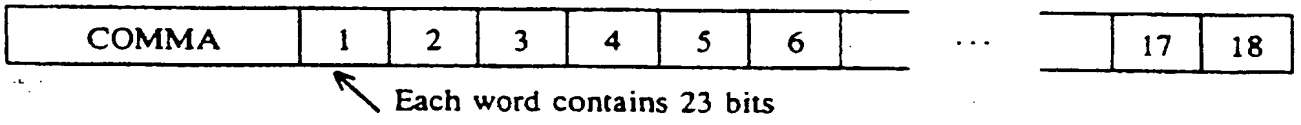
GSC Paging Format

The GSC code format consists of a preamble, a start code, an address and one or more blocks of data. The blocks of data are transmitted at twice the bit rate as the start code and address.



Preamble

The preamble begins with a comma which is 14 bits of a reversal pattern, alternating zeroes and ones. The comma is followed by 18 repetitions of the same 23 bit pattern. There exist 10 different bit patterns in use today. This divides the population of GSC receiving pagers into ten groups. If a pager detects the bit pattern of its group, it will continue to receive the address otherwise it will return to its low current mode. This way, the receiver need only sample often enough to assume that the preamble is detected and pages won't be missed.



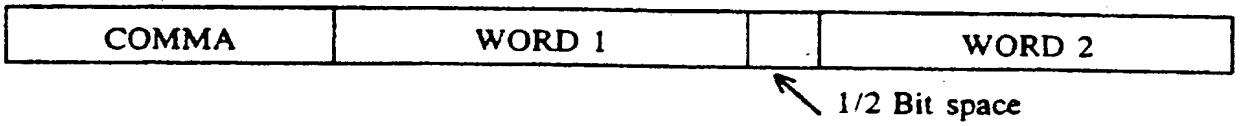
Start Code:

The start code marks the end of the preamble and signals that an address is to follow. It also provides timing information when pages are being sent in batches.

Address:

The start code and address begin with a comma followed by two 23-bit words. These bits are transmitted at 300 bits per second. The two words provide enough data to uniquely define 100,000 different addresses and correct errors in transmission.

START CODE & ADDRESS:



Word Format:

Each 23 bit word begins with 12 information bits followed by 11 parity bits. The parity bits are included to provide a way of detecting bit errors and correcting them. Eleven parity bits are sufficient to correct at most 3 bit errors per word.

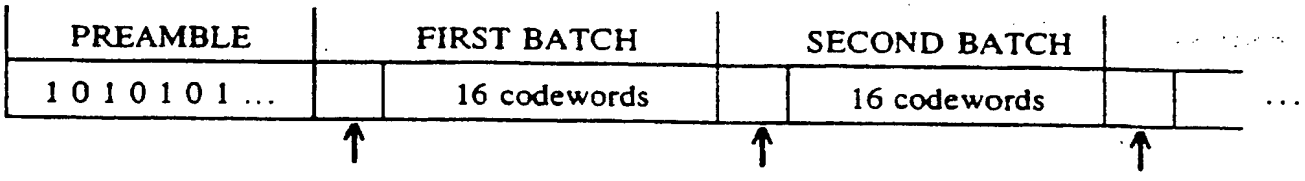
WORD FORMAT:

Data Block Format:

Each block of data begins with a half bit space followed by 8 words of 15 bits each. These bits are transmitted at 600 bits per second which is twice as fast as start code and address bits. The information in each word contains error detection and correction bits but only allows for upper case characters when sending alpha-numeric data.

POCSAG Paging Format:

The POCSAG code format consists of a preamble and one or more batches of data codewords. The batches are separated by a frame synchronization code.



Frame Synchronization codes

Preamble:

The preamble is 576 bits of a reversal pattern, alternating zeros and ones. It is included to alert the receiver that data is to follow. This way, the receiver need only sample often enough to assure that the preamble is detected and pages won't be missed.

Preamble:

1 0 1 0 1 0 1 0 1 0 1 ... for a total of 576 bits

Frame Synchronization Code:

The frame synchronization (FS) code is a unique combination of 32 bits. The FS is used to identify the beginning of each batch of and to provide a starting point by which the frames of data within each batch can be counted.

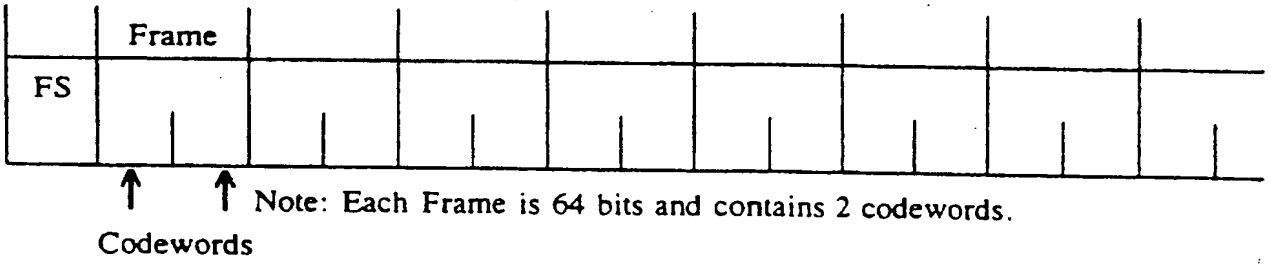
Frame Synchronization Code (32 bits):

0 1 1 1 1 1 0 0 1 1 0 1 0 0 1 0 0 0 0 1 0 1 0 1 1 1 0 1 1 0 0

Batch:

Each batch of data begins with a FS and is followed by 8 frames of data. Each frame of data must contain 2 codewords. Each codeword is 32 bits long. If a page requires an odd number of codewords, an extra idle codeword is used to complete the frame. The idle codeword is a unique pattern like the FS.

Batch:



Idle Code (32 bits):

0 1 1 1 1 0 1 0 1 0 0 0 1 0 0 1 1 1 0 0 0 0 0 1 1 0 0 1 0 1 1 1

Codeword Structure:

Each codeword is 32 bits in length. The first bit indicates the type of data that the codeword contains. A zero in the first bit indicates that the codeword contains address

data. A one in the first bit indicates that the codeword contains message data. In each type of codeword, the data is in bits 2 through 21. Bits 22 through 32 are used as parity bits for error detection and correction algorithms.

Codeword Bit number:

1	2 through 19	20	21	22 through 31	32

Address Codeword:

0	Address bits	Source Id	Parity bits	Even

Message Codeword:

1	Message bits	Parity bits	Even

Address Codeword:

This codeword contains an address in bits 2 through 19 which makes this page specific to one pager within the population of pagers. Included in the 18 bit address are three bits which define the frame (0 through 7) in which the next codeword will be found. The next 2 bits, 20 and 21, identify the source as being from one of four groups of sources within an area. The next 10 bits (22 through 31) are included for error detection and correction and the last bit (32) provides even parity.

Message Codeword:

This codeword contains a 20 bit message of any information in bits 2 through 21. The integrity of these information bits is protected by the error detection and correction routines as the address codewords above. The information bits contain alpha-numeric data encoded as 7 bit ASCII characters.

CLAIMS

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows.

1. A vehicle accessory control system comprising:

a plurality of electrically operated vehicle accessories;

a receiver to be located in a vehicle for receiving paging signals from a land-based paging transmitter, wherein the paging signals include an address uniquely identifying the vehicle and a reprogramming signal for reprogramming the operation of at least one of said plurality of vehicle accessories;

a control circuit communicatively coupled to said receiver and to said plurality of vehicle accessories, said control circuit including:

an input interface for receiving information regarding a plurality of sensed conditions,

a memory for storing a control program,

control means coupled to said input interface and said memory for controlling the operation of said plurality of vehicle accessories in accordance with the control program stored in said memory in response to sensed conditions received from said input interface,

reprogramming means for selectively reprogramming the control program in response to the detection of a paging signal including an address identifying the vehicle and said reprogramming signal, to selectively change the manner in which said control means controls the operation of at least one of said plurality of vehicle accessories.

2. The system as defined in claim 1, wherein said reprogramming means reprograms the control program to selectively change a sensed condition to which said control means is responsive when controlling a particular one of said vehicle accessories.

3. The system as defined in claim 1, wherein said reprogramming means reprograms the control program to selectively change the manner in which said control means controls one of said vehicle accessories in response to a particular sensed condition.

4. The system as defined in claim 3, wherein a particular sensed condition includes a

vehicle operator initiated activation signal and said reprogramming means reprograms the control program to selectively change the manner in which said control means controls one of said vehicle accessories in response to a vehicle operator initiated activation signal.

5. The system as defined in claim 1, wherein said reprogramming means reprograms the control program by modifying a data structure used by the control program in determining the manner by which to control said vehicle accessories.

6. The system as defined in claim 1, wherein said control program includes a plurality of dormant routines each relating to an operation for at least one of said plurality of vehicle accessories, wherein said reprogramming means activates a selected dormant routine in response to a reprogramming signal corresponding to the selected dormant routine.

7. The system as defined in claim 6, wherein said reprogramming means activates a selected dormant routine by setting a flag related to the selected dormant routine.

8. The system as defined in claim 1, wherein said control program includes a plurality of active routines each relating to an operation for one of said plurality of vehicle accessories, wherein said reprogramming means deactivates a selected active routine in response to a reprogramming signal corresponding to the selected active routine.

9. The system as defined in claim 8, wherein said reprogramming means deactivates a selected active routine by resetting a flag related to the selected active routine.

10. The system as defined in claim 1, wherein at least one of said plurality of vehicle accessories is a display for displaying information supplied by said control circuit, and said reprogramming means reprograms the manner in which said display displays the supplied information.

11. The system as defined in claim 1 and further including a display communicatively coupled to said control circuit for displaying information to the vehicle operator indicating that a vehicle accessory has been reprogrammed.

12. A vehicle accessory control system comprising:

an electrically operated vehicle accessory;

a receiver to be located in a vehicle for receiving paging signals from a land-based paging transmitter, wherein the paging signals include an address uniquely identifying the vehicle and a reprogramming signal for reprogramming the operation of said vehicle accessory;

a control circuit communicatively coupled to said receiver and to said vehicle accessory, said control circuit including:

an input interface for receiving information regarding a sensed condition,

a memory for storing a control program,

control means coupled to said input interface and said memory for controlling the operation of said vehicle accessory in accordance with the control program stored in said memory in response to a sensed condition received from said input interface,

reprogramming means for selectively reprogramming the control program in response to the detection of a paging signal including an address identifying the vehicle and said reprogramming signal, to selectively change a sensed condition to which said control means is responsive when controlling said vehicle accessory.

13. The system as defined in claim 12, wherein said accessory includes a plurality of door locks and said reprogramming means reprograms the manner in which said door locks are controlled to respond to a detected speed of the vehicle by locking said door locks when the vehicle reaches a predetermined speed.

14. The system as defined in claim 12, wherein said accessory includes a radio having a volume control and said reprogramming means reprograms the manner in which the radio volume control responds to a speed of a vehicle by increasing the volume of said radio as the speed of the vehicle increases.

15. The system as defined in claim 12, wherein said accessory includes automatic windows and said reprogramming means reprograms the manner in which the automatic

windows respond to a rain sensor by raising said windows when said rain sensor senses rain.

16. The system as defined in claim 12, wherein said accessory is an automatic sunroof and said reprogramming means reprograms the manner in which the automatic sunroof responds to a rain sensor by closing said sunroof when said rain sensor senses rain.

17. The system as defined in claim 12, wherein said accessory is a warning indicator and said reprogramming means reprograms the manner in which said warning indicator responds to a speed of the vehicle by activating said warning indicator when the vehicle reaches a predetermined speed.

18. The system as defined in claim 12, wherein said accessory is a horn and said reprogramming means reprograms said horn to honk in response to the locking of all the vehicle doors following a locking signal transmitted from a remote keyless entry transmitter.

19. The system as defined in claim 12, wherein said accessory includes headlamps and said reprogramming means reprograms said headlights to turn off when a detected vehicle battery voltage is below a predetermined level.

20. A vehicle accessory control system comprising:

an electrically operated vehicle accessory;

a receiver to be located in a vehicle for receiving paging signals from a land-based paging transmitter, wherein the paging signals include an address uniquely identifying the vehicle and a reprogramming signal for reprogramming the operation of said vehicle accessory;

a control circuit communicatively coupled to said receiver and to said vehicle accessory, said control circuit including:

an input interface for receiving information regarding a sensed condition,

a memory for storing a control program,

control means coupled to said input interface and said memory for

controlling the operation of said vehicle accessory in accordance with the control program stored in said memory in response to a sensed condition received from said input interface,

reprogramming means for selectively reprogramming the control program in response to the detection of a paging signal including an address identifying the vehicle and said reprogramming signal, to selectively change the manner in which said control means controls said vehicle accessory in response to a particular sensed condition.

21. The system as defined in claim 20, wherein said reprogramming means reprograms the control program to selectively change the manner in which said control means controls one of said vehicle accessories in response to a vehicle operator initiated activation signal.

22. The system as defined in claim 20, wherein said accessory include headlamps and said reprogramming means reprograms the time at which said headlamps are turned off after a vehicle ignition is turned off.

23. The system as defined in claim 20, wherein said accessory is a rear window defroster and said reprogramming means reprograms the time period during which said rear window defroster remains on after being activated.

24. The system as defined in claim 20, wherein said accessory includes door locks and said reprogramming means reprograms said door locks not to lock in response to an actuation of a door lock switch if a key is in the vehicle's ignition.

25. A vehicle accessory control system comprising:

an electrically operated display;

a receiver to be located in a vehicle for receiving paging signals from a land-based paging transmitter, wherein the paging signals include an address uniquely identifying the vehicle and a reprogramming signal for reprogramming the operation of said display;

a control circuit communicatively coupled to said receiver and to said vehicle accessory, said control circuit including:

an input interface for receiving information regarding a sensed condition,

a memory for storing a control program,

control means coupled to said input interface and said memory for controlling the operation of said display in accordance with the control program stored in said memory in response to a sensed condition received from said input interface,

reprogramming means for selectively reprogramming the control program in response to the detection of a paging signal including an address identifying the vehicle and said reprogramming signal, to selectively reprogram the manner in which said display displays supplied information.

26. The system as defined in claim 25, wherein said reprogramming means reprograms the language of the information to be displayed on said display.

27. The system as defined in claim 25, wherein said reprogramming means reprograms the measurement units for parameters to be displayed on said display.

28. The system as defined in claim 25, wherein said display is an instrument display panel including a plurality of displayed gauges for displaying vehicle parameters, and said reprogramming means reprograms the manner in which said gauges are configured on said instrument display panel.

29. The system as defined in claim 25, wherein said display is a radio display on a radio and said reprogramming means reprograms the default display information which said radio displays on said radio display upon initial activation.

30. The system as defined in claim 25, wherein said display is a message screen of an accessory and said reprogramming means reprograms the manner in which said accessory displays information by reconfiguring said message screen.

31. The system as defined in claim 25 and further including a plurality of displays

coupled to said control circuit, wherein said reprogramming means reprograms which information is to be displayed on each of said displays.

32. A method of reprogramming accessories in a plurality of vehicles from a land based transmission facility comprising the steps of:

transmitting a programming signal from the transmission facility, said programming signal including address information and control information for reprogramming the operation of a vehicle accessory;

receiving the programming signal in a vehicle receiver in each vehicle;

determining in each vehicle if the address of the programming signal matches the address associated with the vehicle; and

reprogramming controlled electrical accessories through the vehicle's electrical system according to the control information in the programming signal for the vehicle in which the address information and vehicle's address match, such that the vehicle's controlled electrical accessories are selectively reprogrammed according to control information transmitted from said transmission facility, wherein reprogramming the vehicle's controlled accessories changes the manner in which the vehicle accessories operate upon reception of vehicle operator initiated operation signals.

33. A system for the remote programming of vehicle accessories to reprogram the operation of said accessories comprising:

at least one land based transmitting facility for receiving instructions from a vehicle operator and initiating transmission of RF programming signals for reception by a vehicle, said RF programming signals including an address uniquely identifying a predetermined vehicle and accessory control information;

a vehicle receiver for receiving said RF programming signals;

a vehicle electrical system, said vehicle electrical system including a multiplex bus and at least one controlled accessory having a controller communicatively coupled to said multiplex bus for controlling said at least one controlled accessory in response to a vehicle operator initiated operation signal; and

a control circuit communicatively coupled to said receiver and to said vehicle electrical system for determining if a received paging signal includes an address which is the address uniquely identifying the vehicle and responsive thereto for reprogramming the

operation of said controlled accessory in response to said accessory control information by changing the manner in which said controller controls the operation of said at least one controlled accessory upon reception of the vehicle operator initiated operation signal.

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Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): G4H (HNEC,HNEE)

Int Cl (Ed.6): H04Q, B60R

Other: Online: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	EP 0131211 A1 (AUDIOPRO MARKETING)	25 at least
A	WO 95/11146 A1 (WHISTLER)	-

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

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